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FODDER QUANTITY AND QUALITY OF SOME MIXTURE CROPS UNDER DROUGHT CONDITIONS

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FODDER QUALITY AND QUANTITY OF SOME MIXTURE CROPS UNDER DROUGHT CONDITIONS

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ABSTRACT

Three field trials were performed at the Agricultural and Veterinary Experimental Station, King Faisal University during the winter season 2000/2001 and repeated in the second season of 2001/2002. The aim was to evaluate forage quantity and quality in the monoculture and mixtures of Egyptian clover + ryegrass, Egyptian clover + barley and Egyptian clover + oat with different seeding rates under different irrigation regimes and nitrogen fertilizer levels.

Each one of the three aforementioned mixture was performed in a separate experiment. A split split-plot design laid out in randomized complete block with four replicates was used. The main plots were assigned to three irrigation intervals, i.e. irrigation every 7, 14 and 21 days with the volumes of water namely; 500, 650 and 800 m^3/ha/irrigation, consuming an irrigation water of 13000, 9200 and 7600 m^3/ha/season, respectively. while the sub plots were devoted to four nitrogen levels (45, 90, 135 and 180 kg N/ha). The sub sub plots were assigned to the following seeding rates of berseem and rye grass or barley or oats in the mixture:

1- Egyptian clover (100%).
2- Ryegrass or barley or oats (100%).
3- 75% clover + 25% ryegrass or barley or oats
4- 50% clover + 50% ryegrass or barley or oats.
5- 25% clover + 75% ryegrass or barley or oats.

Results indicated that the highest fresh and dry forage yields/ha/season were obtained with the irrigation at 7 days intervals and this was obvious for all three mixtures. Increasing nitrogen levels up to the highest rates (135-180 kg N/ha) was associated with marked increases in fresh and dry yields as well as dry matter contents in all mixture trials. In the experiment of Egyptian clover and ryegrass mixture, the highest fresh and dry forage yields/ha/season was obtained from the mixtures of 75 or 50 % Egyptian clover with 25 or 50 % rye-grass. Meanwhile, in the experiments of Egyptian clover and barley or oat mixtures, the monoculture of Egyptian clover produced the highest fresh yield/ha/season. However,

the mixtures of 75 % Egyptian clover and 25 % rye-grass, barley or oat were the suitable and might be the recommended mixing rate for getting the highest fodder yield with best quality of mixtures.

The interaction between irrigation intervals X seeding rates of mixtures and irrigation intervals X nitrogen levels and nitrogen levels X seeding rates had marked effects on forage fresh and dry yields.

In general, it can recommended with mixing Egyptian clover at the rate of 75 % seeds with ryegrass, barley or oat with seeding rate with the rate of 25 % seeds in case of irrigating at the regular interval of 7 days and fertilizing with 135 – 180 kg N/ha for raising mixture forage quantity and quality under Al-Hassa conditions.

INTRODUCTION

Egyptian clover (*Trifolium alexandrinum* L.) is the most important forage legume crop in most of world countries, particularly that has long winter season with cold-moderate temperature. It is grown either in monoculture or together with different grasses such as rye grass, barley and oat. In the Kingdom of Saudi Arabia, Egyptian clover has been introduced with special emphasis to the agriculture sector as untraditional forage crop. The importance of this crop lies on its low irrigation water requirements and the high forage productivity and quality during winter and spring seasons. Thus, numerous studies are necessary to be done for evaluating its cultivation success in terms of forage quality and quantity and its requirement from the irrigation water and nitrogen fertilization either in monoculture or as mixed with grasses.

Selecting the appropriate forage for hay, pasture, and/or conservation use is an important decision facing producers. There is a wide range of grasses and legumes available, and each species has its own particular plant and seed characteristics, making it more or less suitable for a producer's purpose. Thus, this decision is as critical as selecting the best variety within a forage species itself and should be given equal attention.

Many factors have to be taken into account when making a forage selection. One of the foremost is the necessity of matching forage species to the characteristics of the soil to be sown, characteristics such as drainage, fertility, and pH. Crop use and managerial capability are also among the factors that will influence the final decision.

Simple mixtures of one grass and one legume are more desirable than complex mixtures of several grasses and legumes. A legume in the mixture or in pure stands provides higher yields of better quality forage than grass alone. Many legumes, however, cause bloat in ruminant animals, and some producers prefer a pure grass pasture, which sacrifices some yield and quality to safety. Species differ in their ability to compete for light, water, nutrients and space. It is best to grow simple mixtures of two species that complement each other.

LITERATURE REVIEW

The literature of this investigation is divided into several sections and presented as follows:

1- Effect of irrigation regimes on forage yield and quality.
2- Effect of mixtures on forage yield and quality.
3- Effect nitrogen fertilization on forage quality and quantity.
4- Effect of seeding rates of mixtures on forage yield and quality.
5- Effect of interactions on forage yield and quality.

1. Effect of irrigation regimes:

Irrigation management is generally assumed to have a significant effect on growth and yield of many forage crops as clover, barley and oats. Response of white clover to cultural factors is influenced by soil water deficit. Little information exists on the response of white clover to drought

when the crop is grown in association with a grass. Periods of limited soil water are a common occurrence during the summer season in the arid zones as in the Kingdom of Saudi Arabia. These periods can be particularly detrimental to white clover, which is less tolerant of drought than other perennial, temperate forage legumes due to its shallow root system and inability to effectively control transpiration (Hart, 1987).

Competition from associated grasses such as bermudagrass, dallisgrass (*Paspalum dilatatum* Poiret), bahiagrass (*Paspalum notatum* Fluegge), or tall fescue (*Festuca arundinacea* Schreber) places the plant under additional water stress. Plant persistence is dependent on the ability of vegetative stolons to survive these variable periods of drought (Gibson and Cope, 1985; Williams, 1987), which are often accompanied by heat stress as well. Although soil water deficit is recognized as a detriment to white clover growth and persistence, few cultivars or germplasms have been intentionally selected for improved drought tolerance.

Evers (1989) found that persistence was more dependent on annual reseeding than vegetative survival in the Gulf Coast region. This sharp decline in growth during the summer has been observed in the seasonal growth patterns of small, medium, and large leaf germplasm over several years at multiple locations (Brink and Fairbrother, 1995) and probably represents a trend for white clover grown in the Southeast that, when the legume is grown with a grass and grazed, will be difficult to alter by breeding efforts or by cultural practices. Differences in yield and morphology among entries were similar in each of the water-application regimes (no white clover entry x water-application regime interaction).

Brink and Pererson (1998) determined the growth response of white clover to a water-application gradient during the summer and fall on a

Marietta fine sandy loam. They reported that yield and morphology differences among the evaluated clover entries in July were similar in each of the water-application regimes as well. By October, however, there were differences in herbage yield among entries at the high water-application regime, but not at the medium, low, and zero regimes. The results suggest that either there is no difference in drought tolerance among these cultivars and germplasms, or that white clover drought tolerance does not impact growth in the presence of stresses such as grazing and associated grasses. They concluded that the response of white clover to stress should ultimately be determined under conditions normally encountered in the field, which includes defoliation by grazing, competition from an associated grass, drought, heat, and insect and disease pressure.

2. Effect of mixtures:

Mixing the Egyptian clover as a good legume forage crop with some grass forage crops as ryegrass, barley and oats is desired in most cases. Chosing favorable mixtures scores several advantages, i.e. yields of mixtures tend to be greater compared with legume or grass alone. In most cases, legume forage crops have a higher feeding value than non legumes, due to a higher protein and minerals content. Also, legumes supply nitrogen to legume-grass mixtures so it may produce more forage yield than grasses grown alone. The yield of grasses in such mixtures may be greater than its yield when grown in pure stand (solid). Grasses in legume mixtures also contain a higher percentage of protein. Mixtures of grasses and legumes provide a useful model for a better quality diet for animals. The successful mixture need to be selected from these forage crops that mature and harvest simultaneously and that do not severly compete each other for growth and

life requirements (water, light, nutrients, etc..). When mixing forage species, it is very important to use crops that are compatible in growth habit and palatability and complement each other in growth distribution and ecological niche. Therefore, mixture of ryegrass (*Lolium multiflorum* L.) with berseem was proposed to overcome this problem (Rammah and Radwan 1977).

Several investigators revealed that mixtures have been reported to out yield clover or grass in solid planting (Rammah and Radwan 1977; Nor El-Din 1978; Hussein and Abdel-Latif 1982; Nor El-Din et al 1984; Kanayama-Phiri *et. al* 1990; Said and Sharif 1993; Abou-Kresha et al 1996; Ghaffarzadeh 1997 Nuncz-Hernandez et al 1997; Fontaneli et al, 1999; Holland and Brummer, 1999 and Wiersma et al 1999).

Clover-barley mixture has been found to be superior in fresh and dry forage yields than mixtures-ryegrass including wheat and oat (El-Hattab et al 198٢), while clover-oat mixture was superior to mixtures with triticale or barley (Seif and Sedhom, 1988). Nunez-Hernandez et al (1997) reported that berseem clover and its mixtures had higher accumulated dry matter yield than oat monoculture. Clover compatibility with grasses depend on the grass which create densely tillered, close knite swards and all the least conductive to clover development due to inhibition of the growth of clover growing points by shading at ground level (Frame, 1992).

However, grass species differ in their suitability as companion grasses with clover (El-Hattab et al 198٢; Seif and Sedhom 1988 and Holland and Brummer 1999).

3. Effect of nitrogen fertilization:

Nitrogen fertilization plays an active role for increasing forage yield and quality, particularly in the sandy soils that are poor in available nitrogen and an organic matter. Many authors dealt with the necessity application of fertilizers on sandy soils, among them Misra et al. (1980) who reported that increasing level of N significantly increased the straw yield production in barley up to a level of 60 kg N/ha.

One of the most important management factors influencing white clover growth and development in mixed swards is nitrogen (N) fertilization. A vast number of studies have shown that the application of fertilizer N to a mixed sward generally has a positive effect on the growth of the grass component and a negative effect on that of the clover component, although the extent of these effects may vary markedly and the underlying mechanisms are not fully understood. Although the depressive effect of fertilizer N on clover growing point density has yet to be fully explained, it has been suggested that radiation induced changes in the assimilate partitioning pattern within the plant may be involved (eg. Soussana et al., 1995). The actual growing point density is determined by the balance between mortality and the outgrowth of branches from axillary buds.

El-Sayed et al (1996) stated that N fertilizer is the most important macro-element for barley in the poor sandy soil. They stated that barley yield was increased with increasing N level.

Ostrowski and Daczewska (1995) stated that the percentage of *A. repens* decreased on cultivated plots but remained considerable where high N rates were applied. Total yields ranged from 17.11 t/ha with no N

fertilizer to 23.60 t with 240 kg N/ha and corresponding yields of the resown plots were 20.49-24.71 t. CP yields increased by 1.06 t/ha without and 0.47-1.28 t with applied N. Sharief *et al* (1996) reported that nitrogen fertilizer enhanced fresh and dry forage yields of the mixture of clover and ryegrass.

4. Effect of seeding rates in mixture:

Optimum seeding rate in the mixture depends mainly on some factors, as the percentage of seed germination per each crop in the mixture, seedling vigor and size of the mature plants. The size of the mature plant depends on the genetic ability of the species to increase in size and by the amount of open space around the plant. Some forage species can increase in size by tillering (barley, ryegrass , oats, etc..) or by growing larger crowns (alfalfa, Egyptian clover, red clover).

In general, seeding rates of individual species are reduced when combined in mixtures, but the total seeding rate of the mixture may be higher, compared to the solid planting of each.

Rammah and Radwan (1977) indicated that the mixture was significantly out yielded berseem in pure stands. Moreover, Nor El-Din (1978) indicated that the mixture of berseem and ryegrass was significantly higher in green and dry forage yields in comparison with berseem in pure stand. In addition, ash and nitrogen free extract (NFE) were increased and crude protein (CP) decreased in mixture in comparison with berseem in pure stand. Hussein and Abdel-Latif (1982) found that the optimum seeding rate of berseem was 30 kg/fed. mixed with 15 kg./fed. Of barley, which produced higher green and dry matter yield.

Nor El-Din et al (1984). Reported that yield of berseem and barley mixtures were higher than yield of legume or grass in pure stand. El-Hattab et al (198٢) found that berseem – barley mixture was superior in green and dry forage yields than mixtures – ryegrass, including wheat or - oats. Sarhan (1987) found that seeding a mixture of 75% berseem and 25% barley gave the maximum fresh yield. Seif and Sedhom (1988) found that berseem - oats mixture was superior to mixtures with - triticale or - barley. Kanayama-Phiri et. al. (1990), found that the mixture of perennial ryegrass with Iadino clover as maintance of a favorable grass legume balance increased dry matter and protein yield. Said (1992) found that meskawi berseem + barley + ryegrass mixture gave higher total forage production than fahl berseem + barley + ryegrass.

Said and Sharief (1993) reported that mixture of ryegrass and clover produced the most superior yield and its quality than each of them individualy. Abou - Kresha, et al (1996) showed that fresh and dry forage yields and crude protein yield varied significantly with variation in mixture seeding systems compared to pure berseem or barley. Sowing 75% berseem plus 25% barley, 50% berseem plus 50% barley and 25% berseem plus 75% barley gave more yield than pure berseem with 21, 36 and 13% increase for fesh yield, 15, 43 and 21% for dry yield for the same respective treatments.

Juskiw, et al. (2000) conducted three field studies to evaluate the productivity of barley (*Hordeum vulgare* L.), oat (*Avena sativa* L.), triticale (*Triticosecale rimpaui* Wittm.), and rye (*Secale cereale* L.) grown as monocrops or in various mixtures. They reprted tht few effects of seeding rate on yield or quality were found, but when effects were found, higher seeding rates were associated with higher yields, lower moisture content,

and higher fiber content. Although, some exceptions occurred, forage yield and quality of cereal mixtures were generally intermediate to monocrop production,especially for moisture and fiber content, suggesting that planting species mixtures could extend the harvest period and result in higher-quality silage.

Finally, Al-Khateeb et al (2001) stated that the highest fresh forage yield/season was obtained from the monoculture of rye-grass or Egyptian clover and their mixtures of 50 or 25% Egyptian clover with 50 or 75 % rye-grass. The highest total dry matter yields were produced from the monoculture of rye-grass and all its mixtures with Egyptian clover. Moreover, mixtures of Egyptian clover and rye-grass using seeding of 25 and 50 % Egyptian clover with 75 and 50 % rye-grass may be the recommended mixture treatments for getting forage in the longest period with the highest quantity and quality

Compositionally, legumes are known to have higher protein and cell wall fractions, but lower carbohydrate contents than grasses (Waldo and Jorgensen (1981). Nikkhal et al (1995) found that chemical composition and digestion properties of grasses silage were similar to a medium quality of alfalfa. Nor El-Din (1978) indicated that ash and nitrogen free extract (NFE) were higher and crude protein lower in mixture in comparison with clover monoculture. While the reverse was true in ryegrass in pure stand. In order to have balance nutritional diet for animal, optimum mixing rate should be used. Using annual grasses as a companion crops for clover establishment may enhance the overall quality of forage, compared with grass companion crop (Wiersma et al, 1999). Kanayama-phiri et al, (1990) found that the mixture of perennial ryegrass with ladion clover as

maintenance of a favorable grass legume balance increased dry matter and protein yield.

Ghaffarzadeh (1997) conducted a field study to evaluate the economic and biological benefits of oats (*Avena sativa*) crop intercropped with berseem clover (*Trifolium alexandrinum*) in a three crop rotations. He found that oat yield was not significantly affected by intercropping with berseem clover. However, in the 5th year, oat/berseem clover intercrop produced up to 70% more biomass than the sole crop. The biomass (40% oat straw and 60% berseem clover forage) also had adequate digestible material (51%) to be considered as low quality forage. Berseem clover re-growth after oat grain harvest produced an average 1.2 tons/acre of forage, which could have been harvested for hay or left in the field as green manure. During this trial, berseem clover re-growth was left as groundcover and green manure, which contributed an average of 39 lb N/acre to the succeeding maize crop. Maize grain yields following berseem clover were 10% higher over the trial period. Soybean seed yields were the same for both treatments. Intercropping berseem clover with oat returned an average of $39/acre more than the sole crop.

Al-Khateeb et al (2001) reported that the monoculture of Egyptian clover produced the highest protein percentage and yield, while the monoculture of grasses (barley, oat and rye-grass) produced the highest nitrogen free extract percentage and yield.

5. Effects of interactions of the studied factors:

Selection of the species to be used, whether in pure stands or in mixtures, is of major importance in establishing irrigated regimes. Evers (1989) found that differences in yield and morphology among entries did not significantly affected by clover entry x water-application regime

interaction. For good production, irrigated pastures need as much management as most cash crops, or more. Successful pastures must be properly established, fertilized and irrigated for the best dry matter per acre (Glover, et al. 1998).

MATERIALD AND METHODS

Three field trials were performed at the Agricultural and Veterinary Experimental Station, King Faisal University during the winter season 2000/2001 and repeated in the second season of 2001/2002. The aim was to evaluate forage quality and quantity in the monoculture and mixtures of Clover and ryegrass mixture, Clover and barley mixture and Clover and oat mixture as influenced by irrigation regimes and nitrogen fertilizer levels under the Eastern Province of KSA.

Each one of the three aforementioned trials were established separately. A split split-plot design laid out in randomized complete block with four replicates was used. The main plots were assigned to three irrigation intervals, i.e. irrigation every 7, 14 and 21 days with the volumes of water namely; 500, 650 and 800 m^3/ha/irrigation, consuming an irrigation water of 13000, 9200 and 7600 m^3/ha/season, respectively. while the sub plots were devoted to four nitrogen levels (45, 90, 135 and 180 kg N/ha). The sub sub plots were assigned to the following seeding rates of berseem and rye grass or barley or oats in the mixture:

6- Egyptian berseem (100%).
7- Ryegrass or barley or oats (100%).
8- 75% berseem + 25% ryegrss or barley or oats
9- 50% berseem + 50% ryegrss or barley or oats.
10- 25% berseem + 75% ryegrss or barley or oats.

The site of this investigation was the field No.1 at the Agricultural and Veterinary Training and Research Station, King Faisal University (Al-Hassa province). The experimental soil was sand in texture with pH = 7.6, ECe = 5.0 dsm-1, Na, K and Ca contents were 13.9, 29.7 and 10.4 Mmeq/L, respectively of the upper 30 cm of the soil, over the two seasons.),

The experimental unit dimension was 2.5 x 4.0 m (10.0 m^2 i.e. 1/1000 ha). Seed-bed for the experimental field area was well prepared through two perpendicular plowing, residual of the previous crop and weeds removal, perfect leveling. Thereafter, the field area was divided into the basic units (experimental units) by constructing alleys and irrigation channels. Seeds of mixtures were well mixed with the aforementioned seeding rates and hand-drilled in rows, 10 cm apart. Berseem clover "cv. Meskawy", rye-grass "cv. Torero", barley "cv. Jesto" and oat "cv. local" were used with the rate of 60, 20, 160 and 80 kg/ha, respectively. Sowing took place during the last week of October, 2000. After sowing, all plots were fertilized with 50 kg P_2O_5/ha. Nitrogen in the form of Urea with the rate of 135 kg N/ha was added into four portions, prior to sowing, and after each cut, except the last one. Irrigation was done weekly. All recommended agricultural practices were done for all experimental units. In this season, four cuts were taken 60, 105, 145 and 185 days after sowing.

Estimated characters:

- Fresh forage yield (t/ha).
- Dry forage yield (fresh forage yield x DM%).
- Chemical analysis: Representative samples of the mixture treatments over all nitrogen levels and irrigation intervals were oven dried for 48 h at 70 ^oC. It were ground through a 2-mm sieve hammer mill and

prepared for analysis of protein, fiber, ash and ether extract, according to AOAC(1984). Carbohydrates % was calculated as 100 - (protein + ash + fiber + ether extract). Since growth of barley and oat has been decreased after the second cut and totally stopped after the third cut, samples of forage of the first and second cuts were used to estimate the dry matter (DM, method N0. 7.003), crude protein (CP, method No. 7.002), crude fiber (CF, method No. 7.066), ether extract (EE, method No. 7.060) and ash (method No. 7.009) according to standard procedures (Association of Official Analytical Chemist, 1984). Organic matter (OM) contents were calculated as the weight loss upon ashing. Nitrogen free extract (NFE) of the samples was estimated by the difference, i.e. NFE=100–(CP+CF+EE+ash). To recapitulate, the following variables were only resulted and discussed: Crude protein content (CP %), crude fiber content (CF %), organic matter content (OM %) and nitrogen free extract (NFE %). Protein and NFE yields were calculated by multiplying the total dry matter yield of all cuts by averages (first and second cuts) of protein and NFE %, respectively.

Collected data of the fresh and dry fodder yields as well as the dry matter content were subjected to the suitable analysis of variance (AOV) as the technique of combined analysis of the split split plot design in the randomized complete block design. However the data of chemical analysis readings were statistically analysed as the technique of randomized complete block design with four replicates as published by Gomez and Gomez (1984). The treatment means were compared using Waller-Duncan (NLSD) procedure (Waller and Duncan, 1969).

Computations were done using the personal computers (PC) with the famous statistical software "SAS, 6.12" (1996).

RESULTS AND DISCUSSION

The obtained results in this present project was divided into two main sections, the first was concerned with yield and the other fone for chemical analysis of forage. This because the chemical compositions were done only for the mixture treatments (over all irrigation intervals and nitrogen fertilizer levels).

I. Forage yield (fresh and dry) and dry matter content:

In this section, brief notes on the effect of studied factors will be presented for each mixture of the three evaluated mixtures, separately, as follows:

1. Mixture of Egyptian clover and rye-grass:

Averages of the estimated characters in the first, second, third and fourth cuts, over the two seasons, as affected by the studied factors are shown in Tables (1.1 – 1.12). For the simplicity, each one from the studied factors was discussed individually, as follows:

a. Irrigation intervals:

Data listed in Tables (1.1, 1.2 and 1.3) reveal that irrigation intervals had significant effects on the fresh and dry forage yields as well as dry matter percentage of the mixture in the first, second, third and fourth cuts as well as their combined in both seasons of study. Irrigation weekly resulted in the highest fresh and dry forage yields in all cuts and

consequently in their totals, i.e. in their combined over both seasons. Dry matter percentage took the reverse trend, i.e. the lowest values were obtained with the irrigation weekly and increased as irrigation interval increased, i.e. with the exposure of mixture to drought.

Total fresh fodder yield of clover-ryegrass mixture was decreased from 48.411 to 41.783 and 34.968 t/ha as irrigation interval increased from 7 to 14 and 21 days, respectively. This means that the reduction in the fresh forage yield represents 13.69 and 32.17% with increasing irrigation period from 7 to 14 and 21 days, respectively. Meanwhile, increasing the irrigation interval from 14 to 21 days resulted in 16.31 % reduction in the total fresh forage yield, over both seasons.

The dry fodder yield took the same trend of the fresh forage yield. It was markedly decreased as irrigation interval increased. The reduction in the dry fodder yield was 10.97 and 24.72 % with increasing irrigation period from 7 to 14 and 21 days, respectively and reached 12.39 % with increasing irrigation period from 14 to 21 days.

Dry matter percentage of the Egyptian clover and oat mixture was significantly increased as irrigation period was increased. This was obvious in the first, second, third and fourth cut as well as in their general means, over both seasons of study. Over all four cuts in both seasons, dry matter percentage increased from 16.71 % to 17.25 and 18.11 % with prolonging irrigation periods from 7 to 14 and 21 days, respectively. The increase in dry matter contents with exposure mixture plants to drought might be attributed to the lowest moisture content in plant tissues with increasing the irrigation interval.

b. Nitrogen fertilizer levels:

Nitrogen fertilizer levels significantly affected fresh and dry forage yields as well as dry matter content of the Egyptian clover and rye-grass mixture. It is shown from data collected in Tables 1.1, 2.1 and 3.1 that each increase in nitrogen levels from 45 to 90, 135 and 180 kg N/ha was associated with a significant increase in the fresh and dry forage yields in the first, second, third and fourth cuts as well as their total, over both seasons. Also, the effect of nitrogen on dry matter content in the forage was significant in the first and second cuts only, while it did not induce marked effects on this traits in the other two cuts as well as in the combined means of all cuts over the two seasons of experimentation. In general, the increase in nitrogen level was associated with the raise in the dry matter content. The highest level of nitrogen (180 kg N/ha) was associated with the highest means of dry matter percentage, in the first, second and third cuts, over both seasons of study. Meanwhile, the lowest nitrogen rate (45 kg N/ha) was associated with the highest dry matter content in the fourth cut.

Fresh and dry fodder yields produced from all cuts and their total over the two seasons were significantly increased with each increase in nitrogen levels. Total fresh yield all over the complete season (summation fresh yield of all four cuts) was increased from 37.489 to 40.833, 43.193 and 45.007 t/ha as nitrogen level increased from 45 to 90, 135 and 180 kg N/ha, respectively. This represents an increase of fresh yield with rates of 4.20, 10.22 and 20.06% , respectively. The increase in fresh yield with the increase in nitrogen levels might be attributed to the active role of nitrogen in enhancing mixture plants growth and development despite the role of Bacterial nodules on clover roots in nitrogen fixation from the surrounded atmosphere .

Dry fodder yield of all cuts and their total followed the same trend of the fresh forage yield with respect to nitrogen levels. Dry fodder yields of the Egyptian clover and ryegrass in the first, second, third and fourth cuts as well as their total were increased from 6.389 to 6.876, 7.457 and 7.883 t/ha with the increase of the applied nitrogen levels from 45 to 90, 135 and 180 kg N/ha, respectively. This means that the increase of nitrogen rates from 45 to 90, 135 and 180 kg N/ha was associated with an increase of 0.487 , 1.068 and 1.494, representing 7.62, 16.72 and 23.38%, respectively in dry fodder yield, over the two seasons of study.

c. Mixing rate:

Data presented in Tables (1.1, 1.2 and 1.3) show that the evaluated seeding rates of the Egyptian clover and rye-grass mixture had significant effects on fresh and dry forage yields/ha as well as dry matter contents in the mixture forage. This was obvious in the four cuts and their combined, over both seasons of study.

Over both seasons, the highest fresh forage yield of the Egyptian clover and rye-grass mixture (42.980 t/ha) was produced from the mixture of the Egyptian clover and rye-grass with seeding rates of 75% clover + 25 % rye-grass. It was followed (without significant differences) by the mixture of seeding rates of 50 % clover + 50 % rye-grass rates and the mixture of 25% clover + 75 % rye-grass. Meanwhile, solid planting of rye-grass produced the lowest fresh fodder yield, over both seasons. Mixing clover and rye-grass surpassed in the total production of fresh fodder yield / ha / season that produced from the solid planting of clover, over both

seasons. The mixture of 75 or 50 % clover + 25 or 50 % rye-grass, in consequence produced the highest fresh fodder yield in all cuts in both seasons and their combined.

Dry matter contents were markedly affected by the evaluated mixing rates of clover and ryegrass in their mixture. This was clear in the first, second, third and fourth cuts as well as their combined over both seasons. Solid planting of clover produced the highest dry matter percentage in all four cuts and their pooled (18.31 %). Mixing 75 % clover with 25 % ryegrass ranked the second in this concern, producing 17.75 % . On the contrast, the lowest dry matter contents (13.90, 15.90, 16.55 and 18.11 %) were observed with the monoculture of ryegrass (in the first, second, third and fourth cuts, respectively), as shown in Table (1.2).

The dry forage yield of the Egyptian clover and ryegrass mixture significantly varied as seeding rates in the mixture was varied. The highest dry forage yield in the first, second and third cuts as well as total dry forage yield per season was produced from the treatment of mixing 75% clover with 25% ryegrass. However, the monoculture of clover produced the highest dry forage yield in the fourth cut. Over the two seasons of study, the mixture of seeding rates of 50 % clover + 50 % rye-grass ranked the second in dry fodder yield and it was followed by the monoculture of the Egyptian clover. On the other side, the monoculture of ryegrass produced the lowest dry forage yield . This was true in all cuts and their total, over both seasons (Table 1.3).

d. Interaction effects:

Irrigation intervals X nitrogen fertilizer rates: Data presented in Tables (1.4, 1.5 and 1.6) show the averages of fresh forage yield, dray matter

content and dry forage yield/ha in all cuts and their total, over both seasons of study as affected by the interaction between irrigation intervals and nitrogen fertilizer rates. The statistical analysis result showed that shortening the duration period between irrigation to be 7 days with the addition of 180 kg N/ha produced the highest fresh forage yield (51.934 t/ha) and dry forage yield (8.758 t/ha), as shown in Tables 1.4 and 1.6, respectively. On the other hand, the lowest fresh and dry forage yields (31.995 and 5.726 t/ha) were produced from units received an irrigation water each 3 weeks and fertilized with the lowest N level (45 kg N/ha). Dry matter content in the forage was significantly affected by the interaction of irrigation intervals and nitrogen fertilizer rates in the first and second cuts as well as in their combined over both season, while the difference in dry matter content did not reach the level of significance in the third and fourth cuts, over both seasons. The highest dry matter contents in all cuts (16.40, 18.20, 18.80 and 20.50 % in the first, second, third and fourth cuts, respectively) and their combined (18.45 %) were obtained with prolonging irrigation interval to be 21 days with the addition of high nitrogen level (180 kg N/ha). On the other hand, shortening the irrigation interval to 7 days with the addition of low level of nitrogen (45 kg N/ha) was associated with the lowest dry matter content, and this was true in all cuts and their combined, over the two seasons of study.

Irrigation intervals X seeding rates in mixture: Data collected in Tables (1.7, 1.8 and 1.9) show averages of fresh forage yields/ha, dry matter contents and dry forage yields/ha as affected by the interaction between irrigation intervals and seeding rates of Egyptian clover and ryegrass mixture. Data collected in Table (1.7) show that the highest fresh fodder yields in the mixture of the Egyptian clover and ryegrass in the first,

second, third and fourth cuts as well as their total, over both seasons of study were produced by mixing 75 or 50 % Egyptian clover with 25 or 50 % ryegrass in case of shortening the irrigation period to be 7 days. The monoculture of ryegrass in all cuts and their total in both seasons was associated with the lowest dry matter content when the irrigation period increased to 21 days. Dry fodder yield was significantly affected by the interaction of nitrogen levels and seeding rate in the third and fourth cuts as well as the combined of all cuts over both seasons. and The highest dry fodder yields were obtained from the treatment combination of mixing 75 % clover with 25 % ryegrass or from the monoculture of the Egyptian clover in case of shortening the irrigation period to be 7 days. Meanwhile, the monoculture of ryegrass with prolonging the irrigation interval to 21 days recorded the lowest dry matter content, and this was clear in all cuts and their combined means, over both seasons (Table 1.9). The highest dry matter content (19.00, over all cuts and both seasons) was obtained from the monoculture of Egyptian clover when irrigated at 3 or 2-week intervals. Meanwhile, the lowest dry matter content (15.45 %, over all cuts and both seasons) was shown from the monoculture of ryegrass when it was weekly irrigated (Table 1.8).

Nitrogen levels X seeding rates in mixture: Data listed in Tables (1.10, 1.11 and 1.12) show averages of fresh and dry forage yields as well as dry matter content in response to the interaction between nitrogen fertilizer levels and mixing rates. It is shown in Table (1.10) that the highest fresh forage yields in all cuts and their sums (total), over both seasons, were produced from the mixture of 50 % clover + 50 % ryegrass when fertilized with 180 kg N/ha. It was followed by the mixture of 75 % clover and 25% ryegrass ranking the second and the mixture of 25 % clover and 75%

ryegrass ranking the third this concern in case of nitrogen fertilization with the rate of 180 kg N/ha. The monoculture of ryegrass when fertilized with 45 kg N/ha was the lowest treatment combination in the fresh forage yield in all cuts and in the total over both seasons. Dry matter contents were markedly affected by the interaction of nitrogen levels and seeding rate in the first two cuts and in the general means, over the two seasons of study (Table 1.11). The monoculture of Egyptian clover when fertilized with the highest nitrogen rates (180 or 135 kg N/ha) recorded the highest dry matter contents (18.80 and 18.45 %, respectively). On the contrast, the lowest dry matter content (15.40 %, over all cuts in the two seasons) was produced from the monoculture of ryegrass when fertilized with the lowest nitrogen rate (45 kg N/ha). Data listed in Table (1.12) reveal with significant effects for the interaction between nitrogen fertilizer levels and seeding rates of Egyptian clover and ryegrass mixture. This was obvious in all cuts and their sum, over both seasons. The highest total dry forage yield (8.252 t/ha over both seasons) was produced from the mixture of 75 % clover + 25 % ryegrass when fertilized with the highest nitrogen rate (180 kg N/ha). It was followed by the mixture of 50 % clover and 50% ryegrass with the addition of 180 kg N/ha, producing 8.102 t/ha. On the contrast, the lowest dry forage yields were obtained from the monoculture of ryegrass when fertilized with the lowest nitrogen level (45 kg N/ha).

Irrigation intervals X nitrogen levels X seeding rates in mixture: The interaction between irrigation intervals X nitrogen levels X seeding rates in the Egyptian clover and ryegrass mixture did not induce significant effects on the fresh and dry forage yields and the dry matter content. Thus, no more details (tables) are presented in this triple interaction.

Table (1.1): Fresh fodder yield (t/ha) of the Egyptian clover and ryegrass mixture in response to irrigation intervals, N levels and seeding rates (Combined over both seasons)

Treatments	Cut				Total
	First	Second	Third	Fourth	
A. Irrigation intervals:					
7 days	7.883	17.394	17.128	6.005	48.411
14 days	6.742	15.528	14.920	4.592	41.783
21 days	5.654	13.042	12.643	3.627	34.968
NLSD(5%)	1.135	1.216	1.081	1.108	1.892
B. Nitrogen Levels					
45 kg N/ha	5.825	14.323	13.206	4.494	37.849
90 kg N/ha	6.514	14.918	14.831	4.569	40.833
135 kg N/ha	7.018	15.874	15.334	4.966	43.193
180 kg N/ha	7.682	16.171	16.217	4.937	45.007
NLSD(5%)	0.612	0.651	0.605	0.312	0.786
C. Mixing rate					
Clover100%	6.519	14.828	14.418	4.917	40.682
Oat 100%	6.462	14.701	14.221	4.156	39.541
75% Clov+25% Rye	6.939	15.816	15.248	4.976	42.980
50% Clov+50% Rye	6.988	15.728	15.332	4.889	42.937
25% Clov+75% Rye	6.890	15.534	15.266	4.771	42.463
NLSD(5%)	0.315	0.287	0.218	0.169	0.298

Table (1.2): Dry matter (%) of the Egyptian clover and ryegrass mixture in response to irrigation intervals, N levels and seeding rates (Combined over both seasons).

Treatments	Cut				Total
	First	Second	Third	Fourth	
A. Irrigation intervals:					
7 days	13.95	16.25	17.11	19.35	16.71
14 days	14.65	16.80	17.61	20.00	17.25
21 days	15.60	17.60	18.42	20.75	18.11
NLSD(5%)	0.41	0.32	0.30	0.24	0.40
B. Nitrogen Levels					
45 kg N/ha	13.91	16.61	17.45	20.30	17.05
90 kg N/ha	14.30	16.45	17.55	19.95	17.05
135 kg N/ha	15.30	17.05	17.80	19.80	17.50
180 kg N/ha	15.45	17.40	18.05	20.05	17.75
NLSD(5%)	0.31	0.28	N.S	N.S	N.S
C. Mixing rate					
Clover100%	15.30	17.90	18.65	21.35	18.31
Rye 100%	13.90	15.90	16.55	18.11	16.10
75% Clov+25% Rye	15.15	17.30	18.15	20.40	17.75
50% Clov+50% Rye	14.85	16.90	17.75	20.25	17.40
25% Clov+75% Rye	14.4	16.45	17.5	20.00	17.1
NLSD(5%)	0.21	0.22	0.21	0.23	0.26

Table (1.3): Dry fodder yield (t/ha) of the Egyptian clover and ryegrass mixture in response to irrigation intervals, N levels and seeding rates (Combined over both seasons).

Treatments	Cut				Total
	First	Second	Third	Fourth	
A. Irrigation intervals:					
7 days	1.106	2.833	2.931	1.163	8.035
14 days	0.990	2.608	2.633	0.920	7.153
21 days	0.883	2.297	2.335	0.752	6.267
NLSD(5%)	0.283	0.306	0.211	0.209	0.304
B. Nitrogen Levels					
45 kg N/ha	0.801	2.377	2.303	0.907	6.389
90 kg N/ha	0.927	2.449	2.593	0.907	6.876
135 kg N/ha	1.065	2.693	2.72	0.980	7.457
180 kg N/ha	1.180	2.798	2.917	0.987	7.883
NLSD(5%)	0.174	0.182	0.199	0.180	0.231
C. Mixing rate					
Clover100%	0.998	2.644	2.682	1.042	7.366
Rye 100%	0.897	2.335	2.356	0.740	6.329
75% Clov+25% Rye	1.049	2.724	2.761	1.011	7.546
50% Clov+50% Rye	1.032	2.643	2.708	0.985	7.370
25% Clov+75% Rye	0.987	2.551	2.659	0.948	7.146
NLSD(5%)	0.128	0.156	0.148	0.158	0.198

Table (1.4): Fresh fodder yield (t/ha) of the Egyptian clover and ryegrass mixture in response to the interaction between irrigation intervals and nitrogen rates (Combined over both seasons)

Irrigation interval	Nitrogen Rate	Cut				Total
		First	Second	Third	Fourth	
7 days	45 kg N/ha	6.637	15.939	15.145	5.749	43.471
7 days	90 kg N/ha	7.681	17.146	17.117	6.058	48.002
7 days	135 kg N/ha	8.239	17.956	17.784	6.257	50.236
7 days	180 kg N/ha	8.975	18.535	18.465	5.958	51.934
14 days	45 kg N/ha	5.922	14.536	13.184	4.439	38.082
14 days	90 kg N/ha	6.395	14.937	14.654	4.340	40.325
14 days	135 kg N/ha	7.144	16.201	15.368	4.716	43.43
14 days	180 kg N/ha	7.507	16.439	16.473	4.873	45.294
21 days	45 kg N/ha	4.916	12.493	11.29	3.294	31.993
21 days	90 kg N/ha	5.465	12.673	12.721	3.311	34.170
21 days	135 kg N/ha	5.672	13.465	12.849	3.927	35.913
21 days	180 kg N/ha	6.563	13.538	13.712	3.980	37.795
NLSD(5%)		1.056	1.132	1.041	0.565	1.358

Table (1.5): Dry matter (%) of the Egyptian clover and ryegrass mixture in response to the interaction between irrigation intervals and nitrogen rates (Combined over both seasons)

Irrigation interval	Nitrogen Rate	Cut				Total
		First	Second	Third	Fourth	
7 days	45 kg N/ha	13.05	15.95	16.65	19.05	16.15
7 days	90 kg N/ha	13.65	16.10	17.15	19.20	16.55
7 days	135 kg N/ha	14.6	16.45	17.31	19.40	16.90
7 days	180 kg N/ha	14.55	16.65	17.31	19.70	17.05
14 days	45 kg N/ha	13.80	16.50	17.35	20.10	16.95
14 days	90 kg N/ha	14.20	16.30	17.45	20.10	17.00
14 days	135 kg N/ha	15.10	16.90	17.65	19.90	17.40
14 days	180 kg N/ha	15.45	17.30	18.05	20.00	17.70
21 days	45 kg N/ha	14.75	17.35	18.50	21.80	18.10
21 days	90 kg N/ha	15.10	17.05	17.95	20.60	17.65
21 days	135 kg N/ha	16.15	17.75	18.45	20.05	18.15
21 days	180 kg N/ha	16.40	18.20	18.80	20.50	18.45
NLSD(5%)		0.54	0.48	N.S	N.S	0.62

Table (1.6: Dry fodder yield (t/ha) of the Egyptian clover and ryegrass mixture in response to the interaction between irrigation intervals and nitrogen rates (Combined over both seasons)

Irrigation interval	Nitrogen Rate	Cut				Total
		First	Second	Third	Fourth	
7 days	45 kg N/ha	0.863	2.543	2.522	1.098	7.027
7 days	90 kg N/ha	1.050	2.758	2.938	1.163	7.910
7 days	135 kg N/ha	1.204	2.950	3.073	1.216	8.445
7 days	180 kg N/ha	1.308	3.083	3.192	1.175	8.758
14 days	45 kg N/ha	0.816	2.415	2.288	0.897	6.416
14 days	90 kg N/ha	0.908	2.433	2.557	0.875	6.773
14 days	135 kg N/ha	1.078	2.738	2.710	0.936	7.462
14 days	180 kg N/ha	1.160	2.846	2.978	0.974	7.959
21 days	45 kg N/ha	0.725	2.175	2.099	0.727	5.726
21 days	90 kg N/ha	0.822	2.157	2.283	0.682	5.945
21 days	135 kg N/ha	0.912	2.391	2.376	0.787	6.466
21 days	180 kg N/ha	1.072	2.464	2.583	0.813	6.932
NLSD(5%)		0.301	0.315	0.351	0.311	0.409

Table (1.7): Fresh fodder yield of the Egyptian clover and ryegrass mixture in response to the interaction between irrigation intervals and mixing rates (Combined over both seasons).

Irrigation intervals	Mixing rate	Cut				Total
		First	Second	Third	Fourth	
7	Clover100%	7.698	17.045	16.654	6.263	47.660
7	Rye 100%	7.472	16.520	16.503	5.395	45.890
7	75% Clov+25% Rye	8.081	17.691	17.468	6.239	49.479
7	50% Clov+50% Rye	8.190	17.849	17.518	6.195	49.753
7	25% Clov+75% Rye	7.974	17.864	17.497	5.937	49.273
14	Clover 100%	6.583	14.953	14.601	4.863	41.001
14	Rye 100%	6.514	14.852	13.812	3.957	39.135
14	75% Clov+25% Rye	6.881	16.157	15.288	4.918	43.245
14	50% Clov+50% Rye	6.882	15.943	15.612	4.621	43.059
14	25% Clov+75% Rye	6.849	15.737	15.285	4.602	42.474
21	Clover 100%	5.275	12.488	11.998	3.624	33.385
21	Rye 100%	5.402	12.732	12.346	3.117	33.597
21	75% Clov+25% Rye	5.855	13.601	12.988	3.771	36.216
21	50% Clov+50% Rye	5.892	13.391	12.866	3.851	36.000
21	25% Clov+75% Rye	5.847	13.000	13.018	3.775	35.640
NLSD(5%)		0.548	0.478	0.381	0.297	0.526

Table (1.8): Dry matter (5) of the Egyptian clover and ryegrass mixture in response to the interaction between irrigation intervals and mixing rates (Combined over both seasons).

Irrigation intervals	Mixing rate	Cut				Total
		First	Second	Third	Fourth	
7	Clover100%	14.75	17.35	18.20	20.50	17.75
7	Rye 100%	13.10	15.40	15.90	17.65	15.45
7	75% Clov+25% Rye	14.40	16.55	17.60	19.70	17.10
7	50% Clov+50% Rye	14.10	16.20	17.00	19.65	16.75
7	25% Clov+75% Rye	13.45	15.95	16.85	19.30	16.40
14	Clover 100%	15.30	17.75	18.60	21.20	18.20
14	Rye 100%	13.95	15.75	16.60	17.95	16.05
14	75% Clov+25% Rye	15.15	17.15	18.00	20.40	17.65
14	50% Clov+50% Rye	14.65	16.80	17.70	20.35	17.35
14	25% Clov+75% Rye	14.20	16.45	17.30	20.15	17.00
21	Clover 100%	15.95	18.60	19.20	22.40	19.00
21	Rye 100%	14.75	16.45	17.15	18.65	16.75
21	75% Clov+25% Rye	16.00	18.20	18.90	21.20	18.55
21	50% Clov+50% Rye	15.75	17.65	18.60	20.75	18.15
21	25% Clov+75% Rye	15.55	17.05	18.35	20.60	17.85
NLSD(5%)		0.36	0.38	0.36	0.41	0.46

Table (1.9): Dry fodder yield of the Egyptian clover and ryegrass mixture in response to the interaction between irrigation intervals and mixing rates (Combined over both seasons).

Irrigation intervals	Mixing rate	Cut				Total
		First	Second	Third	Fourth	
7	Clover100%	1.140	2.959	3.032	1.283	8.416
7	Rye 100%	0.982	2.547	2.634	0.942	7.106
7	75% Clov+25% Rye	1.169	2.928	3.073	1.231	8.401
7	50% Clov+50% Rye	1.160	2.888	2.969	1.217	8.235
7	25% Clov+75% Rye	1.079	2.845	2.948	1.143	8.016
14	Clover 100%	1.011	2.650	2.710	1.032	7.403
14	Rye 100%	0.910	2.353	2.307	0.702	6.273
14	75% Clov+25% Rye	1.044	2.766	2.753	1.005	7.569
14	50% Clov+50% Rye	1.009	2.681	2.759	0.938	7.387
14	25% Clov+75% Rye	0.976	2.590	2.638	0.925	7.129
21	Clover 100%	0.844	2.323	2.303	0.810	6.280
21	Rye 100%	0.800	2.107	2.126	0.576	5.609
21	75% Clov+25% Rye	0.934	2.477	2.456	0.799	6.667
21	50% Clov+50% Rye	0.928	2.360	2.398	0.800	6.487
21	25% Clov+75% Rye	0.907	2.217	2.391	0.776	6.293
NLSD(5%)		N.S	N.S	0.254	0.274	0.348

Table (1.10): Fresh fodder yield of the Egyptian clover and ryegrass mixture in response to the interaction between irrigation intervals and mixing rates (Combined over both seasons).

N Rate	Mixing rate	Cut				Total
		First	Second	Third	Fourth	
45	Clover100%	5.777	13.535	13.349	4.804	37.466
45	Rye 100%	5.689	13.702	12.916	3.620	35.928
45	75% Clov+25% Rye	5.974	15.095	13.469	4.789	39.328
45	50% Clov+50% Rye	5.918	14.872	13.250	4.682	38.723
45	25% Clov+75% Rye	5.767	14.408	13.048	4.575	37.798
90	Clover 100%	6.268	14.731	14.394	4.752	40.145
90	Rye 100%	6.221	14.271	14.014	4.022	38.529
90	75% Clov+25% Rye	6.623	15.373	15.301	4.699	41.996
90	50% Clov+50% Rye	6.831	15.212	15.226	4.630	41.900
90	25% Clov+75% Rye	6.624	15.007	15.219	4.742	41.593
135	Clover 100%	6.693	15.243	14.670	5.024	41.631
135	Rye 100%	6.707	15.359	14.282	4.519	40.868
135	75% Clov+25% Rye	7.146	16.187	15.874	5.191	44.399
135	50% Clov+50% Rye	7.271	16.286	15.938	5.176	44.672
135	25% Clov+75% Rye	7.274	16.293	15.905	4.922	44.394
180	Clover 100%	7.336	15.803	15.259	5.085	43.484
180	Rye 100%	7.234	15.472	15.669	4.463	42.838
180	75% Clov+25% Rye	8.012	16.611	16.349	5.225	46.197
180	50% Clov+50% Rye	7.933	16.539	16.914	5.067	46.454
180	25% Clov+75% Rye	7.896	16.428	16.895	4.845	46.065
NLSD(5%)		0.636	0.556	0.443	0.332	0.601

Table (1.11): Dry matter (%) of the Egyptian clover and ryegrass mixture in response to the interaction between irrigation intervals and mixing rates (Combined over both seasons).

N Rate	Mixing rate	Cut				Total
		First	Second	Third	Fourth	
45	Clover100%	14.10	17.70	18.40	21.60	17.95
45	Rye 100%	13.00	15.10	15.85	17.65	15.40
45	75% Clov+25% Rye	14.35	17.05	17.90	21.00	17.55
45	50% Clov+50% Rye	13.95	16.80	17.80	20.65	17.30
45	25% Clov+75% Rye	13.85	16.45	17.45	20.65	17.10
90	Clover 100%	14.90	17.40	18.45	21.55	18.10
90	Rye 100%	13.15	15.45	16.40	18.10	15.80
90	75% Clov+25% Rye	14.90	16.75	18.10	20.25	17.50
90	50% Clov+50% Rye	14.55	16.60	17.45	20.15	17.20
90	25% Clov+75% Rye	14.05	16.10	17.25	19.80	16.80
135	Clover 100%	16.05	17.95	18.95	20.80	18.45
135	Rye 100%	14.70	16.25	16.75	18.25	16.45
135	75% Clov+25% Rye	15.75	17.50	18.30	20.10	17.90
135	50% Clov+50% Rye	15.25	17.00	17.70	20.10	17.50
135	25% Clov+75% Rye	14.70	16.50	17.40	19.70	17.05
180	Clover 100%	16.30	18.50	18.80	21.55	18.80
180	Rye 100%	14.85	16.60	17.20	18.30	16.70
180	75% Clov+25% Rye	15.70	17.90	18.30	20.45	18.10
180	50% Clov+50% Rye	15.45	17.05	18.15	20.10	17.70
180	25% Clov+75% Rye	15.00	16.80	17.85	19.85	17.40
NLSD(5%)		0.42	0.44	N.S	N.S	0.52

Table (1.12): Dry fodder yield of the Egyptian clover and ryegrass mixture in response to the interaction between irrigation intervals and mixing rates (Combined over both seasons).

N Rate	Mixing rate	Cut				Total
		First	Second	Third	Fourth	
45	Clover100%	0.811	2.382	2.449	1.025	6.666
45	Rye 100%	0.733	2.087	2.052	0.629	5.502
45	75% Clov+25% Rye	0.850	2.563	2.407	0.992	6.812
45	50% Clov+50% Rye	0.819	2.489	2.342	0.958	6.609
45	25% Clov+75% Rye	0.791	2.368	2.264	0.934	6.358
90	Clover 100%	0.929	2.550	2.647	1.014	7.141
90	Rye 100%	0.812	2.207	2.296	0.718	6.032
90	75% Clov+25% Rye	0.979	2.558	2.771	0.946	7.254
90	50% Clov+50% Rye	0.988	2.519	2.640	0.925	7.072
90	25% Clov+75% Rye	0.923	2.412	2.611	0.934	6.880
135	Clover 100%	1.065	2.727	2.771	1.040	7.604
135	Rye 100%	0.976	2.487	2.389	0.812	6.666
135	75% Clov+25% Rye	1.120	2.818	2.884	1.041	7.864
135	50% Clov+50% Rye	1.103	2.755	2.798	1.039	7.695
135	25% Clov+75% Rye	1.058	2.678	2.756	0.966	7.458
180	Clover 100%	1.188	2.916	2.860	1.089	8.054
180	Rye 100%	1.068	2.562	2.686	0.801	7.118
180	75% Clov+25% Rye	1.246	2.956	2.981	1.068	8.252
180	50% Clov+50% Rye	1.219	2.810	3.053	1.018	8.102
180	25% Clov+75% Rye	1.177	2.746	3.006	0.959	7.888
NLSD(5%)		0.258	0.313	0.303	0.319	0.399

II- Mixing Egyptian clover and barley:

a. Irrigation intervals:

Data collected in Tables (2.1, 2.2 and 2.3) show the effect of irrigation treatments on the fresh and dry forage yields/ha as well as dry matter percentage. Results of the statistical analysis revealed that aforementioned traits were markedly affected by irrigation treatments. Irrigation weekly resulted in the highest fresh and dry forage yields in all cuts and consequently their total (combined). On the other hand, the lowest dry matter percentage of forage was obtained with the irrigation at the regular interval of a week, i.e. dry matter content reached its maximal with prolonging irrigation interval to 3 weeks.

The productivity of the Egyptian clover and barley mixture decreased from 47.523 to 39.838 and 32.736 t/ha with increasing irrigation interval from 7 to 14 and 21 days, respectively. This means that the reduction in the fresh forage yield was 7.685 and 14.787 t/ha . These figures represent 19.29 and 45.17% reduction with increasing irrigation period from 7 to 14 and 21 days, respectively. Increasing the irrigation interval from 14 to 21 days reduced the fresh forage yield with 7.102 t/ha (21.69%), over the two seasons of study. Similar trend was obvious in all four cuts, over both seasons.

Over all cuts and both seasons, dry matter percentage increased from 17.87 to 18.35 and 19.25% with increasing the irrigation period from 7 to 14 and 21 days, respectively (Table 2.2). However, the difference in dry matter content for plants received an irrigation water weekly and that received irrigation water biweekly was not significant. This means that dry matter content took the reverse trend if compared to the fresh fodder yield.

Data collected in Table (2.3) show that that dry fodder yield of the Egyptian clover and barley mixture decreased with the exposure of mixture plants to drought, i.e. with prolonging the irrigation period. Increasing the irrigation period from 7 to 14 and 21 days was associated with marked reduction in dry fodder yield over all four cuts in the two seasons. It decreased with 1.127 and 2.047 t/ha/season. This reduction in dry fodder yield with prolonging irrigation interval to 14 and 21 days was 16.14 and 34.37 %, respectively compared to the irrigation weekly (each 7 days). Increasing irrigation interval from 14 to 21 days resulted in 15.69 % reduction in the dry yield of the Egyptian clover and barley mixture, over both seasons.

b. Nitrogen fertilizer levels:

Nitrogen fertilizer rates had marked effects on the fresh forage yield of the Egyptian clover and barley mixture. It is evident from data presented in Table (2.1) that increasing nitrogen rates from 45 to 90, 135 and 180 kg N/ha was associated with marked increases in the fresh forage yields in the first, second, third and fourth cuts as well as their total, over the two seasons of study. Fresh fodder yield of all cuts and their total (sum of all cuts) significantly increased from 37.286 to 38.368, 40.945 and 43.531 t/ha with the increase of nitrogen rates from 45 to 90, 135 and 180 kg N/ha, respectively. This represents an increase of 2.90, 9.81 and 16.75 %, respectively in total fresh yield over the two seasons. In other words, it can be stated that raising nitrogen level from 45 to 90, 135 and 180 kg N/ha was associated with an increase in the fresh yield of 1.082, 3.659 and 6.245 t/ha, respectively.

Nitrogen fertilizer rates induce a significant increase in the dry matter content in the second and third cuts, while it did not induce

significant effects on dry matter content in the first and fourth cuts as well as in the general averages of all cuts over both seasons. The highest dry matter content was associated with the highest nitrogen level (180 kg N/ha), as shown in Table (2.2).

Over both seasons of investigation, dry fodder yield of all cuts and their total followed the same trend of the fresh fodder yield in response to its effect by nitrogen levels. Dry fodder yields of the Egyptian clover and barley in the first, second, third and fourth cuts as well as in their sum were increased with each increase in nitrogen rates. The addition of nitrogen with the rate of 45, 90, 135 and 180 kg N/ha resulted in marked increase in dry fodder yield. These increases were 0.388, 0.883 and 1.339 t/ha, which represent an increase of 6.04, 13.82 and 20.96 %, respectively in dry fodder yield, over the two seasons. Dry fodder yields in the first, second, third and fourth cuts took similar trend of the total fodder yield.ha/season.

b. Mixing rate :

Mixing rates of the Egyptian clover and barley significantly affected fresh and dry forage yields as well as dry matter contents (Tables 2.1, 2.2 and 2.3). In the first cut, the highest fresh forage yield (16.566 t/ha, over both seasons) was obtained from the monoculture of barley, while in the other three cuts and their total, the highest fresh forage yield was obtained from the mixture of 25% clover + 75% barley. Over the two seasons, the highest forage yield (44.664 t/ha/season, over both seasons) was obtained from the monoculture of clover and from the mixture of 25 % clover and 75 % barley.

Dry matter content was significantly affected by mixing rates in all cuts and in their combined, over the two seasons of experimentation. The dry matter content in the monoculture of barley significantly surpassed that of clover in case of its solid planting, which reached 20.09 %, over both seasons. Mixing 25% clover + 75% barley came in the second rank in this concern (19.14 %). Increasing seeding rate of barley in its mixture with clover resulted with an increase in dry matter content.

The dry forage yield of the Egyptian clover and barley mixture was significantly affected by mixing rates. This was clear in all cuts and their sum (combined), in the two seasons. The monoculture of barley produced the highest dry forage yield in the first cut (2.822 t/ha). Meanwhile, the monoculture of clover produced the highest dry forage yields in the other three cuts (second to fourth cuts) and in the total dry fodder yield/ha/season. Total forage yield/season reached its maximum (7.669 t/ha/season) from the mixture of 25% clover + 75% barley, followed by the mixture of 50 % clover + 50 % barley ranking the second and producing 7.256 t/ha/season. However, the the monoculture of clover ranked the third which produced 7.218 t/ha/seasons, over both seasons without significant differences if compared with the two aforementioned mixture treatments.

d. Interaction effects:

Irrigation intervals X nitrogen fertilizer rates: The interaction between irrigation intervals and nitrogen fertilizer rates had a significant effect on the fresh forage yield in all cuts and their total, over both seasons. Data presented in Tables (2.4) show that increasing irrigation intervals and exposing mixture plants of the Egyptian clover and barley to the drought stress particularly with the lowest N level (45 kg N/ha) resulted in marked reduction in fresh yield/ha/season. The highest fresh fodder yield (51.938/ha/season, over both seasons) was obtained with the irrigation each

7 days and the application of 180 kg N/ha. On the other side, the lowest fresh fodder yield (30.704 t/ha/season) was obtained from the treatment of irrigation each 21 days with the addition of 45 kg N/ha.

Dry matter content was markedly affected by the interaction between irrigation intervals and nitrogen levels in all four cuts and their combined means, over both seasons. The highest dry matter content (19.67 %) was obtained with the irrigation each 21 days and the application of 180 kg N/ha (Table 2.5). On the contrast, the lowest dry matter content (17.36 %) was obtained from the treatment of irrigation each 7 days with the lowest nitrogen rate (45 kg N/ha).

The dry fodder yield followed the fresh forage yield in response to the interaction of irrigation intervals and nitrogen levels (Table 2.6). The highest dry forage yield (5.748 t / ha / season, over both seasons) was obtained with the irrigation weekly and fertilizing with 180 kg N/ha, while the lowest dry fodder yield (3.401 t/ ha / season) was obtained from the treatment of irrigation each 21 days with the addition of low nitrogen level (45 kg N/ha).

Irrigation intervals X seeding rates in mixture: Data in Tables (2.7, 2.8 and 2.9) reveal that the interaction between irrigation intervals and mixing rates markedly affected the fresh and dry forage yields/ha as well as dry matter percentage in all cuts and their combined means. The highest fresh forage yield was taken from the monoculture of clover when irrigated at a regular interval of 7 days. It was followed by the mixture of or 50 or 75% Egyptian clover and 50 or 25% barley. Meanwhile, the lowest fresh fodder yield was produced from the monoculture of barley when irrigated each 21 days.

Dry matter content was markedly affected by the interaction between irrigation intervals and mixing rates (Table 2.8). The highest Dry matter

content was observed with the monoculture of barley when irrigated at a regular interval of 21 days. This was true in all four cuts and in their combined means over both seasons.

Dry fodder yield followed similar trend of the fresh fodder yield in all cuts and in their sum, over both seasons. The highest dry forage yield was produced from the mixture of 25 % clover + 75 % barley, followed by the treatment of 75 or 50 % clover + 25 or 50 % barley, without marked differences. However, the monoculture of barley irrigated each 21 days was associated with the lowest fodder dry yields all over the complete season (Table 2.9).

Nitrogen levels X seeding rates in mixture Data listed in Tables (2.10, 2.11 and 2.12) show values of fresh and dry yields/ha as well as dry matter content in response to the interaction between nitrogen fertilizer levels and mixing rates. It is shown that this interaction had marked effects on the fresh and dry forage yields in all cuts and their sums. The highest fresh forage yield (46.655 t/ha/season) was produced from the monoculture of clover when fertilized with the highest N level (180 kg N/ha). Mixing 25 % clover + 75 % barley when fertiulized 1ith 180 kg N/ha produced the highest dry yield (5.396 t/ha/season). The mixtures of clover and barley with the different seeding rates in case of addition of the highest nitrogen level produced the highest dry forage yields and the differences between these treatments did not reach the level of significant.

The highest dry matter percentage was produced from the monoculture of barley particularly when fertilized with the highest nitrogen rates (135 – 180 kg N/ha). On the other hand, the lowest dry matter percentage was noticed with the monoculture of clover with the addition of 45 kg N/ha.

Table (2.1). Fresh fodder yield (t/ha) of the Egyptian clover and barley mixture in response to irrigation intervals, N levels and seeding rates (Combined over both seasons

Treatments	Cut				Total
	First	Second	Third	Fourth	
A. Irrigation intervals:					
7 days	15.367	16.014	13.151	2.990	47.523
14 days	12.962	13.782	10.755	2.338	39.838
21 days	10.386	11.464	9.062	1.823	32.736
NLSD(5%)	1.091	1.135	1.009	0.971	1.928
B. Nitrogen Levels					
45 kg N/ha	11.704	12.969	10.452	2.160	37.286
90 kg N/ha	12.154	13.382	10.552	2.281	38.368
135 kg N/ha	13.134	14.048	11.278	2.483	40.945
180 kg N/ha	14.628	14.616	11.675	2.611	43.531
NLSD(5%)	0.331	0.397	0.342	0.300	0.473
C. Mixing rate					
Clover100%	6.376	16.680	17.321	4.284	44.664
Barley 100%	16.566	10.807	4.626	0.161	32.145
75% Clov+25% Barley	12.547	14.316	11.183	2.574	40.617
50% Clov+50% Barley	14.045	13.574	10.760	2.392	40.734
25% Clov+75% Barley	15.036	13.324	11.102	2.515	42.001
NLSD(5%)	0.287	0.291	0.238	0.196	0.311

Table (2.2). Dry matter (%) of the Egyptian clover and barley mixture in response to irrigation intervals, N levels and seeding rates (Combined over both seasons).

Treatments	Cut				Total
	First	Second	Third	Fourth	
A. Irrigation intervals:					
7 days	14.97	17.35	18.74	20.37	17.87
14 days	15.53	17.69	19.35	20.77	18.35
21 days	16.47	18.39	20.40	21.82	19.25
NLSD(5%)	0.43	0.38	0.35	0.29	0.50
B. Nitrogen Levels					
45 kg N/ha	15.24	17.39	18.73	20.73	18.04
90 kg N/ha	15.92	17.77	19.33	21.01	18.51
135 kg N/ha	15.66	18.06	19.89	21.05	18.67
180 kg N/ha	15.78	18.04	20.01	21.13	18.72
NLSD(5%)	N.S	0.34	0.32	N.S	N.S
C. Mixing rate					
Clover100%	13.26	15.53	17.36	18.88	16.23
Barley 100%	17.14	19.61	21.33	22.22	20.09
75% Clov+25% Barley	15.42	17.59	19.22	20.98	18.31
50% Clov+50% Barley	16.02	17.89	19.63	21.21	18.67
25% Clov+75% Barley	16.45	18.42	19.97	21.67	19.14
NLSD(5%)	0.30	0.28	0.27	0.26	0.35

Table (2.3). Dry fodder yield (t/ha) of the Egyptian clover and barley mixture in response to irrigation intervals, N levels and seeding rates (Combined over both seasons)

Treatments	Cut				Total
	First	Second	Third	Fourth	
A. Irrigation intervals:					
7 days	2.350	2.754	2.413	0.591	8.108
14 days	2.064	2.411	2.034	0.472	6.981
21 days	1.750	2.091	1.802	0.389	6.034
NLSD(5%)	0.241	0.228	0.201	0.178	0.298
B. Nitrogen Levels					
45 kg N/ha	1.819	2.227	1.910	0.431	6.389
90 kg N/ha	1.980	2.350	1.979	0.465	6.775
135 kg N/ha	2.090	2.502	2.173	0.505	7.272
180 kg N/ha	2.329	2.595	2.270	0.534	7.728
NLSD(5%)	0.211	0.198	0.187	0.169	0.265
C. Mixing rate					
Clover100%	0.835	2.582	3.001	0.806	7.218
Barley 100%	2.822	2.127	0.985	0.035	5.971
75% Clov+25% Barley	1.921	2.507	2.126	0.533	7.091
50% Clov+50% Barley	2.232	2.427	2.096	0.501	7.256
25% Clov+75% Barley	2.469	2.450	2.210	0.540	7.669
NLSD(5%)	0.184	0.177	0.169	0.147	0.213

Table (2.4): Fresh fodder yield (t/ha) of the Egyptian clover and barley mixture in response to the interaction between irrigation intervals and nitrogen rates (Combined over both seasons).

Irrigation interval	Nitrogen Rate	Cut				Total
		First	Second	Third	Fourth	
7 days	45 kg N/ha	14.087	15.296	12.185	2.750	44.318
7 days	90 kg N/ha	14.186	15.539	12.561	2.941	45.227
7 days	135 kg N/ha	15.725	16.266	13.567	3.050	48.610
7 days	180 kg N/ha	17.471	16.956	14.291	3.220	51.938
14 days	45 kg N/ha	11.725	12.785	10.230	2.094	36.836
14 days	90 kg N/ha	12.254	13.256	10.445	2.153	38.109
14 days	135 kg N/ha	13.069	14.304	10.914	2.418	40.706
14 days	180 kg N/ha	14.800	14.781	11.432	2.687	43.700
21 days	45 kg N/ha	9.302	10.825	8.941	1.636	30.704
21 days	90 kg N/ha	10.020	11.349	8.650	1.748	31.768
21 days	135 kg N/ha	10.609	11.574	9.353	1.982	33.519
21 days	180 kg N/ha	11.614	12.109	9.303	1.926	34.953
NLSD(5%)		0.537	0.688	0.592	0.520	0.819

Table (2.5): Dry matter (%) of the Egyptian clover and barley mixture in response to the interaction between irrigation intervals and nitrogen rates (Combined over both seasons).

Irrigation interval	Nitrogen Rate	Cut				Total
		First	Second	Third	Fourth	
7 days	45 kg N/ha	14.78	16.94	17.94	19.89	17.36
7 days	90 kg N/ha	15.36	17.57	18.70	20.43	17.99
7 days	135 kg N/ha	14.75	17.55	19.18	20.62	18.02
7 days	180 kg N/ha	14.95	17.46	19.13	20.47	18.00
14 days	45 kg N/ha	15.18	17.40	18.85	20.42	17.99
14 days	90 kg N/ha	15.80	17.61	19.27	21.00	18.41
14 days	135 kg N/ha	15.63	17.92	19.58	20.84	18.49
14 days	180 kg N/ha	15.56	17.74	19.70	20.92	18.50
21 days	45 kg N/ha	15.83	17.88	19.44	21.94	18.76
21 days	90 kg N/ha	16.66	18.09	20.07	21.65	19.13
21 days	135 kg N/ha	16.57	18.68	20.96	21.78	19.48
21 days	180 kg N/ha	16.79	18.91	21.195	21.93	19.67
NLSD(5%)		0.66	0.58	0.55	0.48	0.69

Table (2.6): Dry fodder yield (t/ha) of the Egyptian clover and barley mixture in response to the interaction between irrigation intervals and nitrogen rates (Combined over both seasons).

Irrigation interval	Nitrogen Rate	Cut				Total
		First	Second	Third	Fourth	
7 days	45 kg N/ha	2.124	2.566	2.143	0.529	4.659
7 days	90 kg N/ha	2.237	2.704	2.291	0.585	4.967
7 days	135 kg N/ha	2.384	2.828	2.535	0.609	5.324
7 days	180 kg N/ha	2.655	2.918	2.683	0.640	5.748
14 days	45 kg N/ha	1.821	2.200	1.884	0.413	3.943
14 days	90 kg N/ha	1.994	2.309	1.960	0.441	4.204
14 days	135 kg N/ha	2.093	2.537	2.086	0.486	4.546
14 days	180 kg N/ha	2.349	2.595	2.206	0.549	4.929
21 days	45 kg N/ha	1.513	1.916	1.702	0.352	3.401
21 days	90 kg N/ha	1.710	2.038	1.687	0.369	3.539
21 days	135 kg N/ha	1.793	2.142	1.900	0.421	3.894
21 days	180 kg N/ha	1.985	2.271	1.920	0.412	4.145
NLSD(5%)		0.365	0.374	0.333	0.298	0.458

Table (2.7): Fresh fodder yield of the Egyptian clover and barley mixture in response to the interaction between irrigation intervals and mixing rates (Combined over both seasons)

Irrigation intervals	Mixing rate	Cut				Total
		First	Second	Third	Fourth	
7	Clover100%	7.815	19.401	19.423	5.435	52.071
7	Barley 100%	18.655	12.371	6.234	0.228	37.488
7	75% Clov+25% Barley	15.448	16.969	14.070	3.364	49.851
7	50% Clov+50% Barley	16.969	15.676	12.799	2.877	48.323
7	25% Clov+75% Barley	17.951	15.655	13.229	3.049	49.884
14	Clover 100%	6.327	16.744	17.325	4.294	44.691
14	Barley 100%	16.912	10.886	4.413	0.158	32.370
14	75% Clov+25% Barley	12.402	14.524	10.714	2.406	40.046
14	50% Clov+50% Barley	14.149	13.614	10.415	2.357	40.534
14	25% Clov+75% Barley	15.020	13.139	10.911	2.477	41.548
21	Clover 100%	4.9895	13.939	15.172	3.129	37.229
21	Barley 100%	14.056	9.2005	3.226	0.096	26.579
21	75% Clov+25% Barley	9.7975	11.476	8.731	1.949	31.954
21	50% Clov+50% Barley	10.904	11.496	9.012	1.932	33.346
21	25% Clov+75% Barley	12.184	11.211	9.167	2.010	34.573
NLSD(5%)		0.499	0.497	0.410	0.338	0.528

Table (2.8): Dry matter (%) of the Egyptian clover and barley mixture in response to the interaction betwee n irrigation intervals and mixing rates (Combined over both seasons).

Irrigation intervals	Mixing rate	Cut				Total
		First	Second	Third	Fourth	
7	Clover100%	12.75	14.97	16.85	18.34	15.72
7	Barley 100%	16.67	18.97	20.81	21.67	19.52
7	75% Clov+25% Barley	14.42	17.28	18.27	19.95	17.47
7	50% Clov+50% Barley	15.15	17.55	18.72	20.57	18.01
7	25% Clov+75% Barley	15.85	18.08	19.07	21.19	18.51
14	Clover 100%	13.11	15.41	17.51	18.80	16.20
14	Barley 100%	17.06	19.76	21.36	22.18	20.06
14	75% Clov+25% Barley	15.30	17.23	18.81	20.98	18.07
14	50% Clov+50% Barley	15.90	17.72	19.28	20.83	18.41
14	25% Clov+75% Barley	16.32	18.27	19.82	21.21	18.88
21	Clover 100%	13.81	16.25	17.76	19.51	16.80
21	Barley 100%	17.63	20.16	21.77	22.85	20.63
21	75% Clov+25% Barley	16.63	18.19	20.58	22.00	19.35
21	50% Clov+50% Barley	16.97	18.39	20.83	22.19	19.61
21	25% Clov+75% Barley	17.26	18.86	21.13	22.56	19.94
NLSD(5%)		0.53	0.48	0.47	0.45	0.61

Table (2.9): Dry fodder yield of the Egyptian clover and barley mixture in response to the interaction between irrigation intervals and mixing rates (Combined over both seasons)

Irrigation intervals	Mixing rate	Cut				Total
		First	Second	Third	Fourth	
7	Clover100%	0.987	2.897	3.268	0.996	5.261
7	Barley 100%	3.107	2.359	1.301	0.049	4.361
7	75% Clov+25% Barley	2.231	2.932	2.572	0.670	5.446
7	50% Clov+50% Barley	2.577	2.752	2.398	0.592	5.317
7	25% Clov+75% Barley	2.848	2.83	2.525	0.646	5.488
14	Clover 100%	0.826	2.582	3.033	0.807	4.537
14	Barley 100%	2.883	2.157	0.946	0.035	3.823
14	75% Clov+25% Barley	1.898	2.504	2.018	0.504	4.413
14	50% Clov+50% Barley	2.259	2.410	2.010	0.490	4.578
14	25% Clov+75% Barley	2.455	2.399	2.163	0.526	4.677
21	Clover 100%	0.685	2.267	2.693	0.610	3.823
21	Barley 100%	2.480	1.864	0.707	0.022	3.148
21	75% Clov+25% Barley	1.629	2.090	1.796	0.428	3.735
21	50% Clov+50% Barley	1.855	2.118	1.878	0.429	3.938
21	25% Clov+75% Barley	2.103	2.120	1.936	0.454	4.079
NLSD(5%)		0.320	0.309	0.291	0.264	0.366

Table (2.10). Fresh fodder yield (t/ha) of the Egyptian clover and barley mixtures in response to the interaction between nitrogen rates and mixing rates (Combined over both seasons).

N rate	Mixing rate	Cut				Total
		First	Second	Third	Fourth	
45	Clover100%	5.956	16.573	16.667	4.083	43.292
45	Barley 100%	14.155	9.268	3.4925	0.120	27.044
45	75% Clov+25% Barley	11.511	13.748	10.726	2.572	38.600
45	50% Clov+50% Barley	12.611	12.595	10.639	1.994	37.901
45	25% Clov+75% Barley	14.219	12.601	10.692	2.033	39.592
90	Clover 100%	6.115	16.547	16.595	4.215	43.460
90	Barley 100%	15.662	10.871	4.341	0.150	31.041
90	75% Clov+25% Barley	11.905	14.179	11.410	2.208	39.671
90	50% Clov+50% Barley	13.340	13.029	9.821	2.272	38.466
90	25% Clov+75% Barley	13.757	12.254	10.619	2.561	39.203
135	Clover 100%	6.535	16.414	17.930	4.377	45.247
135	Barley 100%	17.234	11.389	5.2775	0.185	34.100
135	75% Clov+25% Barley	12.653	14.409	10.975	2.653	40.738
135	50% Clov+50% Barley	14.066	14.108	10.981	2.619	41.770
135	25% Clov+75% Barley	15.176	13.858	11.243	2.585	42.867
180	Clover 100%	6.894	17.231	18.027	4.470	46.655
180	Barley 100%	19.091	11.706	5.387	0.190	36.397
180	75% Clov+25% Barley	14.104	14.926	11.571	2.859	43.459
180	50% Clov+50% Barley	16.006	14.615	11.512	2.670	44.800
180	25% Clov+75% Barley	17.021	14.616	11.871	2.864	46.343
NLSD(5%)		0.576	0.574	0.474	0.390	0.614

Table (2.11): Dry matter (%) of the Egyptian clover and barley mixtures in response to the interaction between nitrogen rates and mixing rates (Combined over both seasons).

N rate	Mixing rate	Cut				Total
		First	Second	Third	Fourth	
45	Clover100%	12.65	15.26	17.07	19.06	16.01
45	Barley 100%	16.76	18.48	20.21	21.98	19.36
45	75% Clov+25% Barley	15.11	17.45	18.46	20.46	17.86
45	50% Clov+50% Barley	15.71	17.71	18.84	20.91	18.28
45	25% Clov+75% Barley	16.13	18.13	19.20	21.31	18.67
90	Clover 100%	13.38	15.68	17.11	18.91	16.27
90	Barley 100%	17.85	19.45	21.28	21.96	20.11
90	75% Clov+25% Barley	15.48	17.51	19.00	21.21	18.27
90	50% Clov+50% Barley	16.25	17.87	19.52	21.40	18.79
90	25% Clov+75% Barley	16.75	18.25	19.78	21.66	19.10
135	Clover 100%	13.21	15.86	17.70	18.85	16.41
135	Barley 100%	17.35	20.43	22.38	22.65	20.69
135	75% Clov+25% Barley	15.31	17.73	19.47	20.96	18.38
135	50% Clov+50% Barley	15.90	17.90	19.76	21.05	18.66
135	25% Clov+75% Barley	16.45	18.35	20.23	21.73	19.19
180	Clover 100%	13.73	15.35	17.50	18.71	16.34
180	Barley 100%	16.55	20.20	21.40	22.34	20.15
180	75% Clov+25% Barley	15.81	17.61	19.96	21.23	18.64
180	50% Clov+50% Barley	16.18	18.11	20.34	21.41	19.02
180	25% Clov+75% Barley	16.58	18.86	20.79	21.89	19.53
NLSD(5%)		0.60	0.56	0.55	0.53	0.69

Table (2.12): Dry fodder yield (t/ha) of the Egyptian clover and barley mixtures in response to the interaction between nitrogen rates and mixing rates (Combined over both seasons)

N rate	Mixing rate	Cut				Total
		First	Second	Third	Fourth	
45	Clover100%	0.743	2.524	2.841	0.772	4.489
45	Barley 100%	2.362	1.705	0.697	0.025	2.905
45	75% Clov+25% Barley	1.731	2.395	1.974	0.516	4.184
45	50% Clov+50% Barley	1.973	2.231	1.997	0.415	4.166
45	25% Clov+75% Barley	2.283	2.283	2.040	0.429	4.264
90	Clover 100%	0.808	2.587	2.836	0.795	4.357
90	Barley 100%	2.793	2.116	0.922	0.03	3.575
90	75% Clov+25% Barley	1.826	2.484	2.139	0.465	4.404
90	50% Clov+50% Barley	2.170	2.33	1.912	0.486	4.389
90	25% Clov+75% Barley	2.305	2.237	2.088	0.550	4.457
135	Clover 100%	0.844	2.586	3.164	0.824	4.62
135	Barley 100%	2.990	2.327	1.173	0.04	4.19
135	75% Clov+25% Barley	1.912	2.543	2.122	0.555	4.553
135	50% Clov+50% Barley	2.217	2.518	2.150	0.547	4.702
135	25% Clov+75% Barley	2.484	2.536	2.260	0.560	4.876
180	Clover 100%	0.933	2.632	3.151	0.834	4.696
180	Barley 100%	3.142	2.361	1.144	0.045	4.438
180	75% Clov+25% Barley	2.208	2.609	2.280	0.602	4.985
180	50% Clov+50% Barley	2.566	2.629	2.325	0.567	5.186
180	25% Clov+75% Barley	2.800	2.739	2.445	0.626	5.396
NLSD(5%)		0.368	0.356	0.328	0.291	0.428

III- Mixing Egyptian clover and oat:

a. Irrigation intervals:

Data listed in Tables (3.1, 3.2 and 3.3) reveal that irrigation intervals significantly affected fresh and dry forage yields as well as the dry matter percentage of the Egyptian clover and oat mixture. Irrigation at regular intervals of 7 days resulted in the highest fresh and dry forage yields in all cuts and consequently in their total yields, while it decreased the dry matter percentage that took the reverse trend.

Over the two seasons of experiments, total fresh fodder yield/ha/season of clover-oat mixture was decreased from 46.526 to 40.401 and 34.138 t/ha as irrigation interval increased from 7 to 14 and 21 days, respectively (Table 3.1). This means that the reduction in the fresh forage yield represented 13.16 and 26.63% with increasing irrigation period from 7 to 14 and 21 days, respectively. Meanwhile, increasing the irrigation interval from 14 to 21 days resulted in 15.20 % reduction in the fresh forage yield . The dry fodder yield took the same trend of the fresh forage yield, where dry yield was significantly decreased as irrigation interval increased. Increasing irrigation period from 7 to 14 and 21 days was associated with 10.53 and 19.71 % reduction in forage yield (Table 3.3).

Data in Table (3.2) show that the dry matter percentage of the Egyptian clover and oat mixture was significantly increased from 17.6 to 18.2 and 19.2 % (Over both seasons) as irrigation intervals increased from 7 to 14 and 21 days, respectively. This was obvious in the first, second, third and fourth cut as well as in their general means.

b. Nitrogen fertilizer levels:

Data presented in Table (3.1) show the effect of nitrogen fertilizer rates on the fresh forage yield of the Egyptian clover and oat mixture in the

first, second, third and fourth cuts as well as their sum, over both seasons. It is shown from the obtained results that the increase in nitrogen rate from 45 to 180 kg N/ha was associated with marked increases in the fresh and dry forage yields in all cuts and in their total. Difference in total fresh and dry yields were increased as nitrogen level increased up to the highest N level (180 kg N/ha). Dry matter contents in the first, third and fourth cuts as well as over the four cuts were markedly increased as nitrogen fertilizer rates increased. The highest rates of nitrogen (135 - 180 kg N/ha) was associated with the highest dry matter percentages (18.7 - 18.8, over all cuts in the two seasons).

c. Mixing rate:

Data in Tables 3.1, 3.2 and 3.3 show averages of fresh and dry yields as well as the dry matter contents of fodder of Egyptian clover and oat in response to their seeding rates. It is clearly appeared that significant differences were found in the fresh and dry yields of forage as well as in the dry matter content in the first, second, third and fourth cuts as well as their combined , over the two seasons of experiments due to the variation in seeding rates of the Egyptian clover and barley mixture. The monoculture of oat recorded the highest fresh and dry forage yields in the first cut, while it recorded the lowest fresh and dry yields in other next three cuts and in the total, over the two seasons. Meanwhile, Egyptian clover produced the lowest fresh and dry forage yields in the first cut only, while it surpassed all tested mixing rates in the second, third and fourth cuts as well as in the total fresh yierld/ha/season. Mixing clover and oat with seeding rates of 75% clover with 25 % oat ranked the second in total fresh fodder yield, while the monoculture of oat recorded the lowest fresh fodder yield/ha/season.

Dry matter content was significantly affected by seeding rates of Egyptian clover and oat in all cuts and their combined means. The dry matter content in the monoculture of oat surpassed that of clover either in monoculture or in its mixtures with oat. In general, each increase in seeding rate of oat in its mixture with clover was associated with a significant increase in dry matter contents, compared to that of the monoculture of Egyptian clover.

d. Interaction effects:

Irrigation intervals X nitrogen fertilizer rates: Data presented in Tables (3.4, 3.5 and 3.6) show fresh and dry forage yields in all cuts and their total as well as on dry matter content as affected by the interaction between irrigation intervals and nitrogen fertilizer rates. Results revealed that maximum fresh and dry fodder yields were obtained from the experimental units that received the irrigation water weekly and fertilized with the highest nitrogen rate (180 kg N/ha). On the other hand, minimum fresh and dry yields were taken from the treatment of irrigation each 21 days with the addition of 45 kg N/ha.

Dry matter content increased as irrigation interval and nitrogen rates increased (Table 3.5). Prolonging the irrigation period to 21 days with the addition of 135 or 180 kg N/ha was associated with the highest dry matter contents in the mixture of the Egyptian clover and oat. On the other hand, the irrigation at 7 days with the application of 45 kg N/ha was associated with the lowest dry matter contents in all cuts (13.5, 16.8, 18.0 and 19.6) and in their combined (17.0 %).

Irrigation intervals X seeding rates: The interaction between irrigation intervals and mixing rates had significant effects on the fresh and dry

yields/ha as well as dry matter percentages in all cuts. Data in Tables (3.7, 3.8 and 3.9) reveal that the highest fresh and dry fodder yields in the first cut were obtained from the treatment of the monoculture of oat when was irrigated weekly. In the other cuts (the second, third and fourth) and the sum of all cuts/ha/season, the mixture of 75% clover + 25 % oat when irrigated each 7 days produced the highest fresh fodder yields (50.272 t/ha/season).

The highest total dry yields were produced from the mixture of clover and oat with the different evaluated seeding rates when were irrigated each 7 days. However, it can be reported that the mixture of 75 % clover + 25 % oat with weekly irrigation may be the recommended for producing the highest fresh and dry yields/season. On the contrary, the lowest total fresh and dry fodder yields were taken from the monoculture of oat when irrigated each three weeks. The highest dry matter contents in the mixture of Egyptian clover and oat were found with the monoculture of oat when irrigated each 21 days, while the lowest dry matter contents were taken from the monoculture of clover when irrigated each 7 days.

Nitrogen fertilizer levels X seeding rates: The fresh and dry yields as well as dry matter contents of the mixture of Egyptian cover and oat were significantly affected by the interaction between nitrogen fertilizer levels and seeding rates of mixture in all cuts and their combined in the two seasons (Tables 3.10, 3.11 and 3.12). Maximum fresh forage yields in the first cut (18.316 and 2.580 t/ha) were taken from the monoculture of oat and the mixture of 25% clover + 75 % oat, respectively when each of them was fertilized with the highest N level (180 kg N/ha). Meanwhile, in the other cuts and total yield/season, the highest fresh forage yield (45.890 t/ha/season) was produced from the monoculture of Egyptian clover when

fertilized with 180 kg N/ha. However, the highest dry forage yields in the second and third cuts (2.598 and 2.471 t/ha) were obtained from the mixture 25% clover + 75 % oat. The same treatment recorded the highest dry fodder yield/ha/season , over the two seasons of study.

Averages of the dry matter content in the mixture of Egyptian clover and oat were increased in the monoculture of oat, particularly when fertilized with the highest nitrogen levels (135 – 180 kg N/ha). Meanwhile, the lowest dry matter content (15.6 %) was taken from the monoculture of clover when fertilized with the lowest nitrogen level (45 kg N/ha).

II- Fodder quality (chemical analysis):

Data collected in Tables 4 and 5 show values of crude protein (CP)%, crude fiber (CF)%, organic matter (OM) % and nitrogen free extract (NFE) %, in the first and second cuts as affected by seeding rates of the examined mixtures, over 2000/2001 and 2001/2002 seasons.

Protein content in the first and second cuts was significantly affected by seeding rate of mixtures. Protein content was highest in monoculture of Egyptian clover in both first and second cuts. The highest protein contents in mixtures were produced from the mixture of 75 % Egyptian clover with 25 % rye-grass, barley or oat. The lowest protein contents were reported in monoculture of oat, barley and rye-grass with the least in rye-grass and barley in the first and second cuts, respectively (Table 3). Waldo and Jorgensen (1981), Kanayama-Phiri *et al*. (1990) and Sharief, *et al.* (1996) came to similar observations. They found that solid planting of Egyptian clover and its mixtures with the highest seeding rate recorded the highest protein percentage.

Wide variations were observed in CF content due to seeding rate in mixtures in the first and second cuts. The highest CF content was found in the monoculture of oat in the first and second cuts as well as the mixture of 50 % Egyptian clover + 50 % barley in the second cuts. Meanwhile, the lowest value of CF was found in Egyptian clover in the first cut and in the monoculture of barley and Egyptian clover and the mixture of Egyptian clover and rye-grass at 50 % for both (Table 3). Haggag *et al.* (1996) came to similar observation. They stated that CF content increased in mixtures than those in pure clover or rye-grass. However, Juskiw *et al.,* (2000) found that as seeding rate increased, CF content increased.

OM content was significantly affected by seeding rates in mixtures in the first cut. The highest OM contents were observed in barley and oat, while the lowest OM content was found in Egyptian clover, rye-grass and their mixtures. This trend of reduction was also more pronounced with the highest seeding rate of Egyptian clover (75%) with all grasses (Table 4). The differences in OM content of the evaluated mixture treatments did not reach the level of significance in the second cut, however the highest OM content was found in the mixture of 50% Egyptian clover + 50% oat and the solid planting of barley.

Mixing treatments had a significant effect on NFE content in the first and second cuts. The highest NFE was associated with the monoculture of barley, while the lowest was found in Egyptian clover. NFE was observed to be low with the highest seeding rate (75 %) of Egyptian clover with all evaluated grasses in both first and second cuts. This trend was much pronounced in the first cut, particularly in barley and oat which can be attributed to the vigorous growth of these grasses early in the season (Table 4). NFE contents have been reported to be higher in mixtures of grasses

and clover, compared with clover monoculture (Nor El-Din, 1978). Also, Haggag, *et al.* (1996) stated that grasses in monoculture or in mixtures with Egyptian clover, particularly with the lowest seeding rates of Egyptian clover (25 %) had the superiority for NFE contents.

Within the evaluated four forage crops, (Egyptian clover as legume, barley, oat and rye-grass, as grasses), rye-grass monoculture had the highest forage yield without significant differences in comparison with the monoculture of Egyptian clover and its mixtures with rye-grass particularly with the highest seeding rates of rye-grass (50 – 75 %). In the same time, Egyptian clover and its mixtures with the evaluated three grasses significantly surpassed all evaluated monoculture grasses in its content from CP and protein yield followed by rye-grass and their mixtures, compared with their corresponding seeding rate mixtures (Table 5). Although NFE comprises the more digestible cellulose and hemicellulose together with the carbohydrates such as sugars. NFE in the present study was higher in all evaluated grasses with no significant differences between them. NFE yield was significantly higher in rye-grass and its mixtures of 75 and 50% with Egyptian clover (Table 5). Thus, mixing Egyptian clover and grasses, particularly rye-grass with the seeding rate of 25 and 50 % Egyptian clover with 75 and % 50 rye-grass could positively affect yield and quality potential of forage produced from mixtures under Al-hassa environmental conditions.

Table (3.1). Fresh fodder yield (t/ha) of the Egyptian clover and oat mixture in response to irrigation intervals, N levels and seeding rates (Combined over both seasons)

Treatments	Cut				Total
	First	Second	Third	Fourth	
A. Irrigation intervals:					
7 days	14.934	15.729	12.872	2.991	46.526
14 days	13.196	13.969	10.983	2.252	40.401
21 days	11.269	11.846	9.328	1.696	34.138
NLSD(5%)	1.285	1.217	1.134	0.895	1.761
B. Nitrogen Levels					
45 kg N/ha	12.561	13.024	10.234	2.188	38.006
90 kg N/ha	12.917	13.869	11.051	2.319	40.156
135 kg N/ha	13.439	13.726	11.103	2.310	40.578
180 kg N/ha	13.615	14.775	11.855	2.434	42.680
NLSD(5%)	0.608	0.594	0.542	0.457	0.772
C. Mixing rate					
Clover100%	6.053	16.444	16.762	4.373	43.632
Oat 100%	17.396	11.758	3.481	0.163	32.797
75% Clov+25% Oat	12.879	14.157	12.059	3.242	42.338
50% Clov+50% Oat	13.898	13.728	11.557	2.190	41.373
25% Clov+75% Oat	15.439	13.153	11.445	1.599	41.636
NLSD(5%)	0.458	0.418	0.311	0.289	0.512

Table (3.2). Dry matter (%) of the Egyptian clover and oat mixture in response to irrigation intervals, N levels and seeding rates (Combined over both seasons).

Treatments	Cut				Total
	First	Second	Third	Fourth	
A. Irrigation intervals:					
7 days	14.3	17.1	18.7	20.3	17.6
14 days	15.2	17.4	19.3	20.9	18.2
21 days	16.6	18.2	20.4	21.7	19.2
NLSD(5%)	0.5	0.4	0.5	0.4	0.6
B. Nitrogen Levels					
45 kg N/ha	14.6	17.0	18.8	20.4	17.7
90 kg N/ha	15.0	17.2	19.3	21.0	18.1
135 kg N/ha	15.8	18.1	19.7	21.2	18.7
180 kg N/ha	16	17.9	19.9	21.3	18.8
NLSD(5%)	0.4	0.4	0.4	0.4	0.5
C. Mixing rate					
Clover100%	13.3	15.5	17.8	18.8	16.3
Oat 100%	16.9	19.1	21.0	22.2	19.8
75% Clov+25% Oat	15.1	17.4	19.2	21.0	18.2
50% Clov+50% Oat	15.5	17.7	19.4	21.1	18.4
25% Clov+75% Oat	15.9	18.1	19.9	21.6	18.8
NLSD(5%)	0.4	0.4	0.4	0.3	0.4

Table (3.3). Dry fodder yield (t/ha) of the Egyptian clover and oat mixture in response to irrigation intervals, N levels and seeding rates (Combined over both seasons).

Treatments	Cut				Total
	First	Second	Third	Fourth	
A. Irrigation intervals:					
7 days	2.200	2.675	2.360	0.590	7.825
14 days	2.055	2.411	2.077	0.457	7.001
21 days	1.907	2.151	1.868	0.356	6.283
NLSD(5%)	0.208	0.200	0.228	0.191	0.382
B. Nitrogen Levels					
45 kg N/ha	1.878	2.2	1.883	0.427	6.388
90 kg N/ha	1.970	2.372	2.076	0.467	6.885
135 kg N/ha	2.157	2.458	2.137	0.474	7.227
180 kg N/ha	2.212	2.619	2.310	0.503	7.644
NLSD(5%)	0.180	0.189	0.139	0.148	0.218
C. Mixing rate					
Clover100%	0.806	2.553	2.973	0.821	7.153
Oat 100%	2.946	2.247	0.732	0.036	5.961
75% Clov+25% Oat	1.924	2.462	2.300	0.676	7.363
50% Clov+50% Oat	2.145	2.426	2.235	0.461	7.267
25% Clov+75% Oat	2.450	2.373	2.270	0.345	7.437
NLSD(5%)	0.138	0.141	0.123	0.108	0.199

Table (3.4). Fresh fodder yield (t/ha) of the Egyptian clover and oat mixture in response to the interaction between irrigation intervals and nitrogen rates (Combined over both seasons).

Irrigation interval	Nitrogen Rate	Cut				Total
		First	Second	Third	Fourth	
7 days	45 kg N/ha	14.240	14.857	11.651	2.765	43.514
7 days	90 kg N/ha	14.570	15.482	12.685	3.185	45.922
7 days	135 kg N/ha	15.257	15.891	13.170	3.029	47.348
7 days	180 kg N/ha	15.670	16.684	13.982	2.984	49.321
14 days	45 kg N/ha	12.459	13.013	10.079	2.125	37.677
14 days	90 kg N/ha	12.945	13.68	10.992	2.164	39.782
14 days	135 kg N/ha	13.663	14.297	11.219	2.293	41.472
14 days	180 kg N/ha	13.717	14.889	11.640	2.427	42.673
21 days	45 kg N/ha	10.983	11.200	8.970	1.674	32.828
21 days	90 kg N/ha	11.235	12.445	9.476	1.608	34.765
21 days	135 kg N/ha	11.398	10.989	8.921	1.608	32.916
21 days	180 kg N/ha	11.460	12.750	9.942	1.892	36.045
NLSD(5%)		1.063	1.022	0.935	0.798	1.338

Table (3.5). Dry matter (%) of the Egyptian clover and oat mixture in response to the interaction between irrigation intervals and nitrogen rates (Combined over both seasons).

Irrigation interval	Nitrogen Rate	Cut				Average
		First	Second	Third	Fourth	
7 days	45 kg N/ha	13.5	16.8	18.0	19.6	17.0
7 days	90 kg N/ha	14.1	16.9	18.4	20.5	17.5
7 days	135 kg N/ha	14.7	17.6	19.1	20.7	18.0
7 days	180 kg N/ha	15.1	17.1	19.2	20.7	18.0
14 days	45 kg N/ha	14.4	16.9	18.8	20.4	17.6
14 days	90 kg N/ha	14.6	17.1	19.3	21.1	18.0
14 days	135 kg N/ha	15.7	17.8	19.4	20.9	18.5
14 days	180 kg N/ha	15.9	17.7	19.6	21.1	18.6
21 days	45 kg N/ha	16.0	17.4	19.7	21.1	18.6
21 days	90 kg N/ha	16.4	17.8	20.2	21.3	18.9
21 days	135 kg N/ha	16.9	18.8	20.7	22.2	19.7
21 days	180 kg N/ha	17.0	18.9	20.9	22.1	19.7
NLSD(5%)		0.7	0.7	0.8	0.7	0.9

Table (3.6). Dry fodder yield (t/ha) of the Egyptian clover and oat mixture in response to the interaction between irrigation intervals and nitrogen rates (Combined over both seasons).

Irrigation interval	Nitrogen Rate	Cut				Total
		First	Second	Third	Fourth	
7 days	45 kg N/ha	1.981	2.482	2.059	0.521	7.043
7 days	90 kg N/ha	2.098	2.601	2.277	0.628	7.605
7 days	135 kg N/ha	2.293	2.781	2.469	0.612	8.155
7 days	180 kg N/ha	2.428	2.834	2.635	0.599	8.496
14 days	45 kg N/ha	1.841	2.181	1.858	0.419	6.299
14 days	90 kg N/ha	1.940	2.315	2.076	0.440	6.772
14 days	135 kg N/ha	2.208	2.531	2.128	0.467	7.335
14 days	180 kg N/ha	2.232	2.617	2.247	0.501	7.598
21 days	45 kg N/ha	1.811	1.936	1.733	0.341	5.823
21 days	90 kg N/ha	1.872	2.201	1.876	0.331	6.280
21 days	135 kg N/ha	1.970	2.060	1.816	0.344	6.191
21 days	180 kg N/ha	1.977	2.405	2.047	0.408	6.838
NLSD(5%)		0.318	0.332	0.247	0.265	0.378

Table (3.7): Fresh fodder yield of the Egyptian clover and oat mixture in response to the interaction between irrigation intervals and mixing rates (Combined over both seasons).

Irrigation intervals	Mixing rate	Cut				Total
		First	Second	Third	Fourth	
7	Clover100%	6.701	18.016	18.852	5.568	49.137
7	Oat 100%	19.111	13.009	4.024	0.219	36.363
7	75% Clov+25% Oat	15.495	16.369	14.285	4.124	50.272
7	50% Clov+50% Oat	16.005	15.856	13.635	2.857	48.354
7	25% Clov+75% Oat	17.360	15.394	13.564	2.186	48.505
14	Clover 100%	5.920	16.718	16.797	4.272	43.707
14	Oat 100%	17.725	11.686	3.327	0.156	32.895
14	75% Clov+25% Oat	12.817	14.551	12.035	3.208	42.610
14	50% Clov+50% Oat	13.910	13.921	11.493	2.064	41.388
14	25% Clov+75% Oat	15.607	12.974	11.261	1.563	41.404
21	Clover 100%	5.538	14.599	14.639	3.277	38.052
21	Oat 100%	15.351	10.579	3.091	0.113	29.135
21	75% Clov+25% Oat	10.327	11.554	9.857	2.393	34.131
21	50% Clov+50% Oat	11.780	11.406	9.541	1.647	34.376
21	25% Clov+75% Oat	13.348	11.093	9.509	1.049	34.999
	NLSD(5%)	0.791	0.727	0.539	0.510	0.887

Table (3.8): Dry matter (%) of the Egyptian clover and oat mixture in response to the interaction between irrigation intervals and mixing rates (Combined over both seasons).

Irrigation intervals	Mixing rate	Cut				Total
		First	Second	Third	Fourth	
7	Clover100%	12.3	14.7	17.2	18.4	15.7
7	Oat 100%	16.1	18.6	20.6	21.7	19.2
7	75% Clov+25% Oat	13.9	17.2	18.1	20.1	17.3
7	50% Clov+50% Oat	14.5	17.5	18.5	20.6	17.7
7	25% Clov+75% Oat	14.9	17.7	19.2	20.9	18.2
14	Clover 100%	13.2	15.3	17.8	18.9	16.3
14	Oat 100%	17.0	19.2	21.0	22.1	19.8
14	75% Clov+25% Oat	15.0	17.2	18.8	21.1	18.0
14	50% Clov+50% Oat	15.2	17.4	19.2	20.9	18.1
14	25% Clov+75% Oat	15.5	17.9	19.7	21.4	18.6
21	Clover 100%	14.6	16.6	18.2	19.2	17.1
21	Oat 100%	17.8	19.5	21.6	22.7	20.4
21	75% Clov+25% Oat	16.5	18.0	20.7	21.8	19.2
21	50% Clov+50% Oat	16.9	18.4	20.7	22.1	19.5
21	25% Clov+75% Oat	17.2	18.7	20.9	22.5	19.8
	NLSD(5%)	0.6	0.6	0.7	0.6	0.7

Table (3.9): Dry fodder yield of the Egyptian clover and oat mixture in response to the interaction between irrigation intervals and mixing rates (Combined over both seasons).

Irrigation intervals	Mixing rate	Cut				Total
		First	Second	Third	Fourth	
7	Clover100%	0.826	2.654	3.251	1.026	7.758
7	Oat 100%	3.095	2.430	0.828	0.047	6.400
7	75% Clov+25% Oat	2.149	2.807	2.590	0.827	8.374
7	50% Clov+50% Oat	2.320	2.765	2.528	0.587	8.202
7	25% Clov+75% Oat	2.608	2.717	2.603	0.461	8.390
14	Clover 100%	0.779	2.571	3.005	0.806	7.162
14	Oat 100%	3.015	2.248	0.700	0.034	5.997
14	75% Clov+25% Oat	1.917	2.499	2.262	0.678	7.357
14	50% Clov+50% Oat	2.127	2.416	2.203	0.431	7.176
14	25% Clov+75% Oat	2.437	2.323	2.216	0.336	7.312
21	Clover 100%	0.811	2.435	2.661	0.631	6.539
21	Oat 100%	2.729	2.063	0.667	0.026	5.486
21	75% Clov+25% Oat	1.706	2.079	2.049	0.524	6.359
21	50% Clov+50% Oat	1.988	2.098	1.972	0.363	6.422
21	25% Clov+75% Oat	1.084				
	NLSD(5%)	0.239	0.244	0.217	0.187	0.343

Table (3.10): Fresh fodder yield (t/ha) of the Egyptian clover and oat mixtures in response to the interaction between nitrogen rates and mixing rates (Combined over both seasons).

N Rate	Mixing rate	Cut				Total
		First	Second	Third	Fourth	
45	Clover100%	5.828	15.941	15.588	4.251	41.609
45	Oat 100%	16.450	11.044	3.200	0.111	30.806
45	75% Clov+25% Oat	12.800	13.219	11.427	3.371	40.817
45	50% Clov+50% Oat	13.491	12.552	10.727	2.146	38.917
45	25% Clov+75% Oat	14.235	12.362	10.225	1.062	37.884
90	Clover 100%	5.870	16.228	16.942	4.246	43.287
90	Oat 100%	17.109	11.502	3.359	0.141	32.111
90	75% Clov+25% Oat	12.973	14.988	11.983	3.308	43.254
90	50% Clov+50% Oat	13.764	13.891	11.530	2.261	41.446
90	25% Clov+75% Oat	14.867	12.735	11.440	1.640	40.682
135	Clover 100%	6.043	16.449	16.827	4.425	43.744
135	Oat 100%	17.708	11.886	3.535	0.186	33.316
135	75% Clov+25% Oat	13.276	13.388	12.141	2.943	41.750
135	50% Clov+50% Oat	14.280	13.567	11.556	2.04	41.444
135	25% Clov+75% Oat	15.888	13.337	11.456	1.957	42.639
180	Clover 100%	6.471	17.158	17.692	4.568	45.890
180	Oat 100%	18.316	12.600	3.828	0.212	34.956
180	75% Clov+25% Oat	12.468	15.034	12.684	3.344	43.531
180	50% Clov+50% Oat	14.058	14.901	12.412	2.311	43.683
180	25% Clov+75% Oat	16.764	14.180	12.658	1.736	45.338
	NLSD(5%)	0.917	0.838	0.628	0.571	1.024

Table(3.11): Dry matter (%) of the Egyptian clover and oat mixtures in response to the interaction between nitrogen rates and mixing rates (Combined over both seasons).

N Rate	Mixing rate	Cut				Total
		First	Second	Third	Fourth	
45	Clover100%	12.0	14.6	17.3	18.6	15.6
45	Oat 100%	16.4	18.5	20.2	21.9	19.3
45	75% Clov+25% Oat	14.6	17.1	18.5	20.1	17.5
45	50% Clov+50% Oat	14.9	17.4	18.9	20.6	17.9
45	25% Clov+75% Oat	15.3	17.7	19.2	20.8	18.3
90	Clover 100%	13.2	15.1	17.4	18.6	16.1
90	Oat 100%	16.4	18.6	21.1	22.6	19.7
90	75% Clov+25% Oat	14.8	17.1	19.2	21.2	18.1
90	50% Clov+50% Oat	15.2	17.7	19.3	21	18.3
90	25% Clov+75% Oat	15.4	17.7	19.7	21.4	18.6
135	Clover 100%	13.9	16.1	18.1	19.0	16.8
135	Oat 100%	17.6	19.9	21.3	22.0	20.2
135	75% Clov+25% Oat	15.3	18.0	19.5	21.3	18.5
135	50% Clov+50% Oat	15.8	18.1	19.6	21.8	18.8
135	25% Clov+75% Oat	16.4	18.5	20.3	22.1	19.3
180	Clover 100%	14.3	16.3	18.3	19.1	17.0
180	Oat 100%	17.4	19.3	21.4	22.3	20.1
180	75% Clov+25% Oat	15.7	17.6	19.6	21.7	18.6
180	50% Clov+50% Oat	16.1	17.8	20.0	21.3	18.8
180	25% Clov+75% Oat	16.6	18.4	20.4	22.2	19.4
NLSD(5%)		0.7	0.7	0.8	0.7	0.8

Table (3.12). Dry fodder yield (t/ha) of the Egyptian clover and oat mixtures in response to the interaction between nitrogen rates and mixing rates (Combined over both seasons).

N Rate	Mixing rate	Cut				Total
		First	Second	Third	Fourth	
45	Clover100%					2.994
45	Oat 100%	1.712	2.237	1.800	0.416	6.166
45	75% Clov+25% Oat	2.319	2.225	1.397	0.371	6.312
45	50% Clov+50% Oat	1.966	2.190	2.032	0.578	6.767
45	25% Clov+75% Oat	2.093	2.181	1.938	0.296	6.507
90	Clover 100%	1.365	2.269	2.439	0.482	6.557
90	Oat 100%	1.800	2.322	1.908	0.414	6.444
90	75% Clov+25% Oat	2.359	2.374	1.515	0.400	6.649
90	50% Clov+50% Oat	2.047	2.519	2.199	0.551	7.317
90	25% Clov+75% Oat	2.207	2.337	2.191	0.405	7.140
135	Clover 100%	1.460	2.427	2.670	0.591	7.148
135	Oat 100%	1.971	2.471	1.918	0.449	6.810
135	75% Clov+25% Oat	2.561	2.495	1.581	0.312	6.949
135	50% Clov+50% Oat	2.168	2.364	2.263	0.554	7.350
135	25% Clov+75% Oat	2.537	2.406	2.205	0.413	7.561
180	Clover 100%	1.596	2.633	2.833	0.669	7.732
180	Oat 100%	2.062	2.627	2.018	0.461	7.169
180	75% Clov+25% Oat	2.548	2.563	1.708	0.431	7.252
180	50% Clov+50% Oat	2.110	2.595	2.422	0.554	7.682
180	25% Clov+75% Oat	2.580	2.598	2.471	0.455	8.104
NLSD(5%)		0.276	0.284	0.248	0.218	0.396

Table (4). Averages of crude protein content (CP %) and crude fiber content (CF %) of forage mixtures in the first and second cuts as affected by the evaluated mixing treatments (Over both seasons).

Character		CP %		CF %	
Seeding rate		First cut	Second cut	First cut	Second cut
Monoculture (100 %)	Clover (C)	20.3	23.0	14.10	15.75
	Rye (R)	12.2	16.5	17.25	16.50
	Barley (B)	14.6	15.7	17.47	15.37
	Oat (O)	14.3	16.4	19.22	18.52
Clover 75%	+ 25% R	18.3	22.9	15.30	15.90
	+ 25% B	19.8	22.9	15.02	17.42
	+ 25% O	18.8	22.2	16.05	17.22
Clover 50%	+ 50% R	16.7	21.3	15.02	15.60
	+ 50% B	17.9	20.1	15.62	19.27
	+ 50% O	17.7	21.1	17.97	16.97
Clover 25%	+ 75% R	14.5	21.8	15.97	17.75
	+ 75% B	17.2	19.3	16.32	16.20
	+ 75% O	16.1	20.2	17.60	17.42
F. Test		**	**	*	*
NLSD(5%)		1.2	1.4	1.32	1.24

Table (5). Averages of organic matter content (OM %) and nitrogen free extract (NFE %) of forage mixtures in the first and second cuts as affected by the evaluated mixing treatments (Over both seasons).

Character / Seeding rate		OM %		NFE %	
		First cut	**Second cut**	**First cut**	**Second cut**
Monoculture (100 %)	Clover (C)	81.3	81.2	44.3	40.0
	Rye (R)	81.7	82.9	50.4	48.1
	Barley (B)	86.9	84.1	52.2	50.7
	Oat (O)	88.4	82.4	51.8	45.5
Clover 75%	+ 25% R	81.9	82.5	46.5	42.0
	+ 25% B	82.3	82.6	49.2	40.8
	+ 25% O	80.2	82.8	48.8	41.6
Clover 50%	+ 50% R	86.6	82.8	48.8	43.9
	+ 50% B	87.3	83.2	50.9	42.2
	+ 50% O	87.1	84.9	47.7	42.8
Clover 25%	+ 75% R	86.6	82.9	47.8	41.6
	+ 75% B	86.2	82.6	50.9	47.1
	+ 75% O	88.3	81.7	51.6	42.2
F. Test		*	NS	**	**
NLSD(5%)		6.1	---	2.18	1.98

Table (6). Averages of total crude protein and nitrogen free extract yields (ton/ha) obtained from the evaluated mixing treatments (Over both seasons).

Character / Seeding rate		Protein Yield (ton/ha)	NFE Yield (ton/ha)
Monoculture (100 %)	Clover (C)	1.900	3.700
	Rye (R)	1.465	5.026
	Barley (B)	1.057	3.589
	Oat (O)	1.420	4.499
Clover 75%	+ 25% R	1.788	3.840
	+ 25% B	1.721	3.627
	+ 25% O	1.783	3.931
Clover 50%	+ 50% R	1.771	4.321
	+ 50% B	1.355	3.319
	+ 50% O	1.659	3.870
Clover 25%	+ 75% R	1.697	4.179
	+ 75% B	1.221	3.278
	+ 75% O	1.543	3.986
F. Test		**	**
NLSD(5%)		0.214	0.354

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جودة وكمية العلف من المخاليط العلفية تحت ظروف جفافية

نفذت ثلاثة تجارب زراعية بحقل التجارب رقم ١ بمحطة الأبحاث والتجارب الزراعية والبيطرية – جامعة الملك فيصل خلال موسمي٢٠٠٠/٢٠٠١ و كررت للمرة الثانية خلال موسم ٢٠٠١/٢٠٠٢ م. وقد احتوت التجربة الأولى على مخلوط علفي مكون من البرسيم المصري وحشيشة الراي. واحتوت التجربة الثانية على مخلوط البرسيم المصري والشعير، في حين احتوت التجربة الثالثة على مخلوط البرسيم المصري و الشوفان. وقد نفذت كل تجربة منهم بنظام تصميم القطع المنشقة ثنائيا في قطاعات كاملة العشوائية ذو أربع مكررات ، حيث خصصت معاملات الري للقطع الرئيسية وكانت كما يلي: الري كل ٧، ١٤، ٢١ يوم (مستهلكة ماء ري قدره ١٣٠٠٠، ٩٢٠٠، ٧٦٠٠ م^{٣}/هكتار/موسم، على الترتيب). بينما خصصت القطع الشقية لمستويات السماد النتروجينى (٤٥، ٩٠ ، ١٣٥ و ١٨٠ كجم ن/هكتار). وقد أظهرت نتائج الدراسة ما يلي:

١. أشارت نتائج الدراسة أن مخلوط البرسيم المصري و حشيشة الراي بمعدل خلط ٧٥ أو ٥٠% برسيم مصري + ٢٥ أو ٥٠ % حشيشة الراي والري أسبوعيا والتسميد النتروجيني بمعدل ١٣٥-١٨٠ كجم ن / هكتار قد نتجت أعلى محصول علفي (رطب وجاف) ، وقد تفوق على الزراعة المنفردة للبرسيم المصري و حشيشة الراي.

٢. تفوقت زراعة البرسيم المصرى منفردا على باقي معاملات الخلط في مخلوط البرسيم المصري والشعير . ومع هذا فقد أدى معدل خلط ٢٥ % برسيم مصري + ٧٥ % شعير مع الري أسبوعيا والتسميد النتروجيني بمعدل ١٣٥-١٨٠ كجم ن / هكتار إلى الحصول على أعلى محصول علفي (رطب وجاف).

٣. تفوقت زراعة البرسيم المصرى منفردا على باقي معاملات الخلط في مخلوط البرسيم المصري والشوفان. إلا أن معدل خلط ٧٥ % برسيم مصري + ٢٥ % حشيشة الراي والري أسبوعيا والتسميد النتروجيني بمعدل ١٣٥-١٨٠ كجم ن / هكتار إلى الحصول على أعلى محصول علفي (رطب وجاف).

٤. بلغ محصول البروتين أقصاه مع الزراعة المفردة للبرسيم المصري وقد تلاه في ذلك معدل خلط ٧٥ % برسيم + ٢٥% حشيشة الراي.

٥. خلط حشيشة الراي مع البرسيم المصري بمعدل تقاوي ٧٥ % برسيم + ٢٥ % راي والري كل أسبوع والتسميد بمعدل ١٣٥-١٨٠ كجم ن/هكتار كانت هي المعاملة الموصى بها لزيادة انتاجية وجودة المخاليط العلفية.