Response of Two Egyptian Clover Varieties (*Trifolium alexandrinum* L.) to N P Fertilization and Seeding Rates in Newly Reclaimed Sandy Soils Under Sprinkler Irrigation System

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Abstract: *two field experiments were conducted during 2003/2004 and 2004/2005 at the Experimental Farm, Faculty of Agriculture, Suez Canal University at Ismailia, Egypt, to study the effect of two NP levels (40 Kg N +15.5 kg P_2O_5/fed and 80 Kg N + 31 kg P_2O_5/fed) and three seeding rates (20, 25 and 30 kg/fed) on two Egyptian clover varieties (Meskawy and Helaly) in sandy soils under sprinkler irrigation system. Increasing NP level from 40 Kg N + 15.5 kg P_2O_5/fed to 80 Kg N + 31 kg P_2O_5/fed resulted significant increases in plant height, number of branches/plant, fresh and dry forage yields/fed, crude protein content (%) and protein yield/fed in all cuts as well as total fresh, dry forage and protein yields/fed. Number of branches/plant as well as leaves/stems fresh and dry weight ratio and crude protein content (%) were significantly increased by decreasing seeding rate from 30 kg to 20 kg seed/fed, while plant height and fresh and dry forage yields/fed at different cuts as well as total fresh and dry forage yields/fed were significantly increased by increasing seeding rate from 20 to 25 Kg/fed during the two seasons. Helaly variety significantly surpassed Meskawy cv. in fresh and dry forage yields/fed, crude protein content(%) and protein yield/fed in all cuts as well as number of branches/plant in second cut and total fresh, dry forage and protein yields/fed during the two seasons. It is worthy to mention that the optimum forage yield of berseem in sandy soils of Ismailia governorate under sprinkler irrigation system was achieved by sowing Helaly cv. with seeding rate 25 Kg/fed and applying 80 Kg N+31 Kg P_2O_5/fed.*

Key words: *Berseem (Trifolium alexandrinum* L.*), NP fertilization, seeding rates, varieties.*

INTRODUCTION

For several decades ago, berseem occupied one third of the Egyptian cultivated area in winter season, mostly in Nile valley and Delta. In the last few years, the Egyptian agricultural policy is aiming to decrease the area under berseem in the Nile valley to be replaced mainly by wheat in these fertile clay soils to face deficiency of wheat production. Meanwhile, it is of great importance to extend area of berseem in the newly cultivated sandy soils. In this respect using good varieties and suitable dose of fertilizers as well as adapting seeding rates and agricultural practices for the crop on these lands should be studied. In Egypt, berseem is the main source of fodder for animal feeding especially in winter season, because of its higher protien content, low content of fibers and high moisture content. Also, it fixes more than 714000 tons of atmospheric N_2 annually in Egypt (El-Nahrawy *et al.*, 1996). It improves chemical and physical properties of soil and it is important for soil conservation and reclamation. Forage yield and quality of Egyptian clover are influnced by many factors such as NP fertilization, seeding rates and varieties.

Application of nitrogen and phosphorus fertilizers generally increased green and dry yields/fed, some agronomic characters viz. plant height, number of branches/plant, green and dry forage weight/plant as well as protein percentage and protein yield/fed (El-Hakeem, 1981; Wahdan 1982; Shaaban *et al.* 1984; El-Sheikh, 1986; Said and Sharief, 1993; Abo El-Goud, 1994; Zagloul, 1995; El-Nahrawy *et al.*, 1996; Ali *et al.* 1997; Aly, 1999 and Hassan, 2000).

Regarding **seeding rates**, Kandil (1978) stated that increasing **seeding rate** increased fresh forage yield/fed. Assey ***et al.*** (1980) found significant reduction in **number of branches**/plant in 2nd and 3rd cuts due to the **increase of** seeding rate from 15 to 20 and 25 Kg/fed. **However**, the forage yield/fed was significantly **increased, but** the dry yield/fed was not increased **by raising seeding** rate. Similar results were recorded by **Hussein** *et al.* (1983) and Shaaban *et al.* (1984). Also, increasing seeding rate from 15 to 25 kg/fed increased the fresh forage yield significantly at the first cut and total production of the first season (Aly, 1989). Increasing seeding rate of Fahl cv. from 15 to 18.75 kg/fed significantly increased plant height by 10.30%, whereas dry weight of plant was significantly decreased as seeding rates increased up to 22.5 kg/fed (El-Sheikh, 1998). Moreover, Sarhan and Abd El-Maksoud (2002) found that increasing seeding rate from 15 to 30 Kg/fed increased plant height and fresh and dry forage yields/fed, while number of branches/plant was decreased.

Regarding varieties of berseem, several investigators showed wide variation among varieties in growth parameters, fresh and dry forage yields/fed, protein percentage and protein yield (Bakheit, 1986; Younis *et al.*, 1988; Abd El-Halim *et al.*, 1993; Ramadan *et al.*, 1994; Ahmed and Mohamed, 1995; Gaballah, 2001 and Sarhan and Abd El-Maksoud, 2002).

Therefore, the aim of this work was to study the effect of N + P fertilizers levels and seeding rates on two varieties of Egyptian clover in sandy soils under sprinkler irrigation system at Ismailia governorate.

MATERIALS & METHODS

Two field experiments were conducted during 2003/2004 and 2004/2005 seasons at the Experimental Farm, Faculty of Agriculture, Suez Canal University at Ismailia to study the effect of NP ferilization and seeding rates on two varieties of Egyptian clover under sprinkler irrigation system.The soil of experiments was sandy with pH values of 7.93 and 7.85 and contained 3.79 and 4.11 ppm of available N, 1.66 and 1.82 ppm available P and 9.75 and 10.58 ppm available K in the two seasons, respectively. Every experiment included 12 treatments, which were the combinations of two levels of N + P fertilizers (40 Kg N + 15.5 kg P_2O_5/fed and 80 Kg N + 31 kg P_2O_5/fed), three seeding rates (20, 25 and 30 kg seed/fed) and two multicuts varieties Egyptian clover (Meskawy and Helaly).

The experimental design was split-split plots with four replications. Two levels of NP fertilization were allocated randomly in the main plots, three seeding rates were arranged randomly in the sub plots and two varieties were allocated randomly in sub-sub plots. Each experimental sub-sub plot consisted 16 rows, 4 m in length and 15 cm in width (Plot area = 9.6 m^2). Phosphorus in the form of calcium superphosphate fertilizer (15.5% P_2O_5) at the mentioned levels was applied before sowing. While, nitrogen in the form of ammonium sulphate (20.6% N) at mentioned rates and a basal dose of 80 Kg potassium sulphate (48% K_2O) were added at foure equal doses, where the first dose was added at 35 days after sowing, while the other three doses were added after first, second and third cuts.

All seeds of Egyptian clover were coated by Arab gum and inoculated with the specific Rhizobium strain immediately before sowing. Seeds were sown on 30 and 20 October in the first and second seasons, respectively. The normal cultural practices for growing Egyptian clover crop at Ismailia governorate were followed. The sprinkler irrigation system was used. The total amount of water consumed throught the growth season attained 5734 and 5611 m^3/fed in the two seasons, respectively. Four cuts were obtained in each season. The first cut was after 68 days from sowing, the second cut was after 53 days from the first cut, the third cut was after 47 days from the second cut and the fourth cut was after 39 days from the third cut.

At each cut, samples of ten guarded plants were randomly taken from each plot to determine plant height (cm), number of branches/plant, leaves/stems fresh weight ratio and leaves/stems dry weight ratio. While, fresh and dry forage yields/fed were estimated for the four cuts from the plants of the whole plot area and the yields per fed were calculated. Dry forage yield (ton/fed) estimated from randomly selected oven dried samples at 70° C until constant weight. Crude protien content (%) was determined in the dry matter by using the modified Micro Kjeldahal Apparatus according to methods outlined by A.O.A.C (1975), then the obtained values were multiplied by 6.25 as used by Tripathi *et al.* (1971). Protein yield per fed was also estimated by multiplying the dry forage yield per fed and crude protein content(%).The analysis of variance of split-split plots design was used according to Snedecor and Cochran (1982). Means followed by the same alphabetical letters are not statistically different according to Duncan's Multiple Range Test (L.S.R) at the 0.05 level of significance (Duncan, 1955).

RESULTS AND DISCUSSION

1-Plant height:-

Data in Table (1) show that increasing NP fertilizer level from 40 Kg N + 15.5 kg P_2O_5/fed to 80 Kg N + 31 kg P_2O_5/fed resulted significant increase in plant height and that was held true in all cuts during the two seasons. These findings may be due to the positive effects of N and P on cell division and meristemic activity, which in turn increased number and length of internodes resulting in taller plants. Similar results were detected by Shaaban *et al.* (1984), Ali *et al.* (1997) and Hassan (2000).

Concerning seeding rate, data in Table (1) show that plant height was significantly increased by increasing seeding rate from 20 kg to 25 kg per fed, but the difference was not significant between 25 and 30 kg per fed. That was true in the four cuts during the two seasons except in the first cut in 2004/2005 season .These results are in harmony with those reported by El-Sheikh (1998) and Sarhan and Abd El-Maksoud (2002).

With regard to varieties, Meskawy cv. plants significantly surpassed Helaly cv. in plant height in the second and third cuts, but the differences between them were not significant in the first and fourth cuts and that was true in the two seasons (Table 1). These results might probably be due to the genetic differences between varieties as well as to differences in their response to environmental conditions (climatic and edaphic). These findings were confirmed by Gaballah (2001) and Sarhan & Abd El-Maksoud (2002).

Over all treatments, the tallest plants were recorded for third cut followed by second and first cuts, respectively. While the shortest plants were obtained in fourth cut. That was true in the two seasons.

2-Number of branches per plant:-

Results in Table (2) exhibit that applying 80 Kg N + 31 kg P_2O_5/fed gave significant increase in number of branches per plant compared to 40 Kg N + 15.5 kg P_2O_5/fed and that held true in the four cuts in each season. These results might be due to favorable effects of N and P on cell division and meristemic activity as well as metabolic activity. These results are in the same line with the findings detected by El-Sheikh (1986) and Zagloul (1995).

It is obvious from Table (2) also that number of branches per plant was significantly increased by decreasing seeding rates from 30 to 25 and 20 kg seed/fed in the first and second cuts during both seasons. The same trend was true in the third and fourth cuts, but the difference between 20 and 25 kg seed/fed was not great enough to reach the 5% level of significance and that held true in the two seasons. These results might be due to that in thin plant population (20 kg seed/fed) there was little competition among plants for growth factors such as space, moisture, nutrients and

light, in turn resulted in better growth of individual plants. Confirming results were obtained by Assey *et al.* (1980) and Sarhan & Abd El-Maksoud (2002).

Regarding varieties, Helaly cv. significantly outnumbered Meskawy cv. in number of branches/plant in the 2 th cut only, but the differences between them were not significant in other cuts during both seasons. These results might be due to differences in genetic constitutions between varieties. These findings are in harmony with those reported by Bakheit (1986) and Sarhan & Abd El-Maksoud (2002).

Over all treatments, the highest value of number of branches/plant was obtained in third cut followed by second, fourth and first cuts, respectively in both seasons.

3- Leaves/stems fresh weight ratio:-

Data in Table (3) show that increasing NP fertilization from 40 Kg N + 15.5 kg P_2O_5/fed to 80 Kg N + 31 kg P_2O_5/fed increased leaves/stems fresh weight ratio significantly in the first and second cuts and insignificantly in the third and fourth cuts during both seasons. The increase in leaves/stems fresh weight ratio in the first and second cuts by increasing NP fertilizer level might be due to that leaves formation rate were greater than stems during these stages of plant age as well as moisture percentage in leaves is higher compared to stems. While in the third and fourth cuts, the plant growth was slowly because of inhibition N fixation by nodule bacteria in the advanced stage of plant age as well as decreasing metabolic activity of plants toward senescence. Similar results were found by El-Hakeem (1981), Shaaban *et al.* (1984) and Hassan (2000).

Results in Table (3) reveal that sceding rate of 20 kg/fed significantly increased leaves/stems fresh weight ratio compared to 30 kg/fed in all cuts during both seasons as well as 25 kg seed/fed in all cuts except third cut in 2003/2004 season and the second cut in the 2004/2005 season. On the othe hand, decreasing seeding rate from 30 to 25 kg seed/fed gave significant increase in leaves/stems fresh weight ratio only in second cut in 2004/2005 season as well as third and fourth cuts in 2003/2004 season. These findings might be due to that in thin plant population (20 Kg seed/fed) the increase in rate of formation fresh weight of leaves/plant was higher compared to fresh weight of stems/plant. These results are in agreement with those reported by Shaaban *et al.* (1984).

Meskawy cv. significantly exceeded Helaly cv. in leaves/stems fresh weight ratio only in second and fourth cuts during the two seasons. Whereas, the differences between the two varieties were not great enough to reach the 5 % level of significance in the first and third cuts in both seasons. These results are in accordance with those recorded by Abd El-Halim *et al.* (1993).

Over all treatments, the highest value of leaves/stems fresh weight ratio was detected in first cut, then decreased gradually up to fourth cut in 2003/2004 seasons, while in the second one, the highest value was produced in the first cut followed by third, second and fourth cuts, respectively.

4 - Leaves/stems dry weight ratio:-

It is obvious from Table (4) that nitrogen and phosphorus fertilization levels did not affect significantly leaves/stems dry weight ratio in all cuts during the both seasons except 3 th cut in 2004/2005 season. Similar results were recorded by El-Hakeem (1981), Shaaban *et al.* (1984) and El-Sheikh (1986).

Table (4) revealed that 20 kg seed/fed resulted in significant increase in leaves/stems dry weight ratio as compared with 25 and 30 Kg seed/fed in all cuts in both seasons. On the other hand, 25 kg seed/fed surpassed significantly 30 kg seed/fed only in the second cut in 2004/2005 season and third cut in the two seasons. Confirming results were found by Shaaban *et al.* (1984).

Meskawy cv. significantly exceeded Helaly cv. in leaves/stems dry weight ratio in all cuts in both seasons, except that the differences between the two cvs in this respect did not attain the 5% level of significance in third and fourth cuts in the first season (2003/2004) as shown in Table (4). The reduction in leaves/stems dry weight ratio of Helaly cv. may be due to it had more number of branches/plant compared to Meskawy cv. These findings are in agreement with those detected by Bakheit (1986).

Over all treatments, the highest value of leaves/stems dry weight ratio was obtained in second cut followed by first, third and fourth cuts, respectively and that was true in both seasons.

5- Fresh forage yield (ton/fed):-

It is clearly evident from data in Table (5) that fresh forage yield/fed was significantly increased by increasing NP fertilizer level from 40 Kg N + 15.5 kg P_2O_5/fed to 80 Kg N + 31 kg P_2O_5/fed and that held true at different cuts during both seasons. The positive effect of NP on fresh forage yield/fed might be due to beneficial effects of N and P on plant height and number of branches/plant. These results are in the same line with those reported by Wahdan (1982), Said and Sharief (1993), Abo El-Goud (1994), Ali *et al.* (1997), Aly (1999) and Hassan (2000).

Table(5) shows also that fresh forage yield/fed was significantly increased as seeding rate increased from 20 to 25 kg seed/fed, while increasing seeding rate from 25 to 30 Kg seed/fed increased this trait insignificantly and that was true in all cuts through both seasons. The increase in fresh forage yield/fed by increasing seeding rate may be attributed to higher number of plants per unit area of land at high seeding rate and consequently more utilization of nutrients from soil as well as great amount of light energy was intercepted by plants and converted to dry matter. Moreover, the higher number of plants per unit area in dense sowing was great enough to counterbalance the reduction in yield components of individual plants. It is with great importance to obtain the maximum yield per unit area rather than the maximum yield per individual plant. These results are in agreement with those obtained by Kandil (1978), Assey *et al.* (1980), Hussein *et al.* (1983), Shaaban *et al.* (1984), Aly (1989) and Sarhan & Abd El-Maksoud (2002).

Table (1): Effect of NP fertilization, seeding rates and varieties on plant height(cm) of berseem at the different cuts in the two seasons.

Seasons	First cut		Second cut		Third cut		Fourth cut	
Treatments	2003/2004	2004/2005	2003/2004	2004/2005	2003/2004	2004/2005	2003/2004	2004/2005
Fertilization (NP)								
N1P1	35.98 b	45.17 b	48.57 b	57.76 b	47.96 b	58.35 b	34.24 b	42.31 b
N2P2	40.04 a	49.20 a	60.50 a	64.34 a	61.44 a	66.26 a	37.89 a	47.4 a
F.Test	*	*	*	*	*	*	*	*
Seeding rates (D)								
20kg/fed.	35.54 b	41.88 c	50.00 b	55.80 b	51.82 b	58.49 b	34.12 b	41.15 b
25kg/fed.	38.85 a	46.21 b	55.86 a	63.19 a	56.12 a	65.81 a	36.88 a	44.62 a
30kg/ed.	39.64 a	53.50 a	57.84 a	64.18 a	56.16 a	64.60 a	37.27 a	48.79 a
F.Test	*	*	*	*	*	*	*	*
Varieties (V)								
Meskawy	38.54 a	47.15 a	56.55 a	63.34 a	57.00 a	65.51 a	35.55 a	44.16 a
Helaly	37.48 a	47.23 a	52.52 b	58.76 b	52.40 b	59.10 b	36.57 a	45.55 a
F.Test	NS	NS	*	*	*	*	NS	NS
Over all treatments	38.01	47.19	54.53	61.05	54.70	62.30	36.06	44.85

* Significant at 0.05 level of probability N1P1= 40 Kg N + 15.5 kg P_2O_5 / fed, N2P2 = 80 Kg N + 31 kg P_2O_5/fed

Table (2): Effect of NP fertilization, seeding rates and varieties on number of branches/plant of berseem at the different cuts in the two seasons.

Seasons	First cut		Second cut		Third cut		Fourth cut	
Treatments	2003/2004	2004/2005	2003/2004	2004/2005	2003/2004	2004/2005	2003/2004	2004/2005
Fertilization (NP)								
N1P1	2.18 b	2.47 b	3.15 b	3.27 b	5.00 b	5.03 b	2.66 b	3.24 b
N2P2	2.63 a	3.29 a	3.77 a	3.73 a	5.82 a	5.70 a	4.05 a	4.45 a
F.Test	*	*	*	*	*	*	*	*
Seeding rates (D)								
20kg/fed.	2.85 a	4.08 a	4.43 a	4.35 a	6.20 a	6.14 a	3.77 a	3.97 a
25kg/fed.	2.44 b	2.48 b	3.26 b	3.32 b	5.80 a	5.69 a	3.65 a	3.76 a
30kg/fed.	1.91 c	2.09 c	2.71 c	2.83 c	4.24 b	4.26 b	2.63 b	3.81 b
F.Test	*	*	*	*	*	*	*	*
Varieties (V)								
Meskawy	2.45 a	2.74 a	3.12 b	3.27 b	5.36 a	5.32 a	3.38 a	3.86 a
Helaly	2.35 a	3.02 a	3.81 a	3.74 a	5.47 a	5.41 a	3.32 a	3.83 a
F.Test	NS	NS	*	*	NS	NS	NS	NS
Over all treatments	2.40	2.88	3.46	3.50	5.41	5.36	3.35	3.84

* Significant at 0.05 level of probability N1P1= 40 Kg N + 15.5 kg P_2O_5 / fed, N2P2 = 80 Kg N + 31 kg P_2O_5/fed

Table (3): Effect of NP fertilization, seeding rates and varieties on leaves/stems fresh weight ratio of berseem at the different cuts in the two seasons.

Seasons	First cut		Second cut		Third cut		Fourth cut	
Treatments	2003/2004	2004/2005	2003/2004	2004/2005	2003/2004	2004/2005	2003/2004	2004/2005
Fertilization (NP)								
N1P1	1.21b	1.39 b	0.80 b	0.90 b	0.72 a	0.75 a	0.60 a	0.64 a
N2P2	1.74 a	1.80 a	1.18 a	1.21 a	0.73 a	1.43 a	0.62 a	0.65 a
F.Test	*	*	*	*	NS	NS	NS	NS
Seeding rates (D)								
20kg/fed.	1.88 a	1.83 a	1.25 a	1.31 a	0.88 a	1.45 a	0.84 a	0.74 a
25kg/fed.	1.28 b	1.50 b	0.92 b	1.03 a	0.75 a	0.93 b	0.56 b	0.60 b
30kg/fed.	1.27 b	1.45 b	0.80 b	0.83 b	0.55 b	0.90 b	0.43 c	0.58 b
F.Test	*	*	*	*	*	*	*	*
Varieties (V)								
Meskawy	1.53 a	1.65 a	1.19 a	1.27 a	0.75 a	1.43 a	0.65 a	0.74 a
Helaly	1.42 a	1.54 a	0.78 b	0.84 b	0.70 a	0.75 a	0.57 b	0.56 b
F.Test	NS	NS	*	*	NS	NS	*	*
Over all treatments	1.74	1.59	0.98	1.05	0.72	1.09	0.61	0.65

* Significant at 0.05 level of probability N1P1= 40 Kg N + 15.5 kg P_2O_5 / fed, N2P2 = 80 Kg N + 31 kg P_2O_5/fed

Helaly cv. outyielded Meskawy cv. in fresh forage yield/fed with significant difference between them in all cuts through the two seasons, except in the fourth cut in second season (Table 5). The superiority of Helaly cv. in fresh forage yield/fed may be due to its higher number of branches/plant. These results are in harmony with those detected by Younis *et al.* (1988), Abd El-Halim *et al.* (1993), Ramadan *et al.* (1994) and Gaballah (2001).

Over all treatments, the highest value for fresh forage yield/fed was recorded in second cut followed by third and fourth cuts, respectively, while first cut ranked the last one in the first season. But in the second season, the highest value was obtained in second cut followed by third, first and fourth cuts, respectively.

6- Dry forage yield (ton/fed):-

Data in Table (6) exhibit that dry forage yield/fed was increased as NP fertilizer level increased from 40 Kg N + 15.5 kg P_2O_5/fed to 80 Kg N + 31 kg P_2O_5/fed with significant difference between them in all cuts during both seasons. 80 Kg N + 31 kg P_2O_5/fed surpassed 40 Kg N + 15.5 kg P_2O_5/fed in dry forage yield/fed by 23.5% and 16.7% in first cut, 47.4% and 30.9% in the second cut, 16.1% and 53.1% in the third cut and 12.9% and 22.8% in the fourth cut, in the two seasons, respectively. These results might be due to favorable effects of N and P on plant growth characters such as plant height and number of branches/plant as well as increasing dry matter accumulation in plants particularly that the soil of experiments had very low contents of available nitrogen and phosphorus. These results are in a good agreement with those observed by Said and Sharief (1993), Ali *et al.* (1997), Aly (1999) and Hassan (2000).

Data in Table (6) indicate that the highest dry forage yield/fed at each cut was obtained with seeding rate 30 Kg/fed but differences between 25 Kg/fed and 30 Kg in this respect were not significant in the first three cuts while in the fourth cut differences among the three studied seeding rates were significant regarding the effect on this trait. That was true in the two seasons. The beneficial effect of increasing seeding rate on dry forage yield/fed might be due to increasing number of plants per unit area of land in higher seeding rate, which in turn resulted in more effective use of growth factors such as nutrients, moisture and light consequently increasing dry matter accumulation per unit area of land, finally increasing dry forage yield/fed. Confirming results were reported by Hussein *et al.* (1983), Shaaban *et al.* (1984) and Sarhan & Abd El-Maksoud (2002).

Helaly cv. significantly outyielded Meskawy cv. in dry forage yield/fed in different cuts during both seasons. The highest value was achieved by Helaly cv. in third cut in 2004/2005 season, while the lowest value was obtained by Meskawy cv. in first cut in 2003/2004 season. These results may be due to that Helaly cv. had more number of branches/plant and higher fresh forage yield/fed as compared to Meskawy cv. These findings are in agreement with those detected by Bakheit (1986), Younis *et al.* (1988), Ramadan *et al.* (1994), Gaballah (2001) and Sarhan & Abd El-Maksoud (2002).

Over all treatments, the different cuts could be arranged in a descending order with regard to dry forage yield/fed as follows: third, second, fourth and first cuts, respectively. That was true in the two seasons.

7- Crude protein content (%):-

Data in Table (7) indicate that adding 80 Kg N + 31 kg P_2O_5/fed gave significant increase in crude protein content (%) as compared to 40 Kg N + 15.5 kg P_2O_5/fed in all cuts during the two seasons. These results were expected since nitrogen is a constituent of amino acids, proteins and coenzymes as well as enhances plant metabolism. Moreover, phosphorus developed good root system in turn improved capacity of roots to absorb more nutrients, also P stimulates nodulation, N fixation and protein synthesis. Similar results were reported by Said and Sharief (1993), Abo El-Goud (1994) and Hassan (2000).

Also, it is clearly evident from Table (7) that crude protein content (%) in forage of each cut decreased consistently as seeding rate had been increased up to 30 Kg/fed. The differences among the three studied rates were significant in first and second cuts, while in the third and fourth cuts differences between 25 and 30 Kg seed/fed were not significant and both resulted forage with protein % significantly less than that of 20 Kg seeding rate. These results held true in each season. The increase in crude protein content (%) in plants at low seeding rate (20 kg seed/fed) might be interpreted by the fact that at lower plant population, there was lower competition exists among plants for growth factors such as nutrients, moisture, space and light which affected positively growth and metabolic processes such as synthesis of protein in tissues of plants.

Helaly cv. significantly exceeded Meskawy cv. in crude protein content (%) in all cuts in the two seasons (Table 7). These results may be due to the originitiel genetical make up differences of the grown varieties. These findings are in harmony with those found by Ramadan *et al.* (1994) and Gaballah (2001).

Regardless the effect of the studied factors, the first cut gave the highest crude protein content (%), then the values decreased gradually, where the lowest value was achieved in fourth cut and that held true in both seasons.

8-Protein yield (kg/fed):-

Results in Table (8) reveal that protein yield (kg/fed) was significantly increased by increasing NP fertilizer level from 40 Kg N + 15.5 kg P_2O_5/fed to 80 Kg N + 31 kg P_2O_5/fed and that held true in all cuts during the two seasons. The increases attained 44.4% and 31.9% in the first cut, 57.1% and 42.2% in the second cut, 25.7% and 67.1% in the third cut and 24.7% and 34% in the fourth cut in the two seasons, respectively. The increase in protein yield (kg/fed) by increasing NP fertilization level could be due to the increase in dry forage yield/fed and crude protein content (%).Similar results were reported by Said and Sharief (1993), Zagloul (1995) and Ali *et al.* (1997).

Table (4): Effect of NP fertilization, seeding rates and varieties on leaves/stems dry weight ratio of berseem at the different cuts in the two seasons.

Seasons	First cut		Second cut		Third cut		Fourth cut	
Treatments	2003/2004	2004/2005	2003/2004	2004/2005	2003/2004	2004/2005	2003/2004	2004/2005
Fertilization (NP)								
N1P1	0.80 a	0.94 a	0.82 a	1.01 a	0.76 a	0.76 b	0.59 a	0.67 a
N2P2	0.83 a	0.96 a	0.83 a	1.03 a	0.81 a	0.94 a	0.67 a	0.70 a
F.Test	NS	NS	NS	NS	NS	*	NS	NS
Seeding rates (D)								
20kg/fed.	0.95 a	1.11 a	1.05 a	1.31 a	0.93 a	0.96 a	0.71 a	0.82 a
25kg/fed.	0.81 b	0.89 b	0.75 b	0.94 b	0.79 b	0.86 b	0.61 b	0.67 b
30kg/fed.	0.68 b	0.86 b	0.68 b	0.80 c	0.63 c	0.73 c	0.57 b	0.58 b
F.Test	*	*	*	*	*	*	*	*
Varieties (V)								
Meskawy	1.08 a	1.16 a	1.04 a	1.21 a	0.80 a	0.94 a	0.64 a	0.72 a
Helaly	0.55 b	0.75 b	0.61 b	0.83 b	0.77 a	0.76 b	0.62 a	0.65 b
F.Test	*	*	*	*	NS	*	NS	*
Over all treatments	0.81	0.95	0.82	1.02	0.78	0.85	0.63	0.68

* Significant at 0.05 level of probability N1P1= 40 Kg N + 15.5 kg P_2O_5 / fed, N2P2 = 80 Kg N + 31 kg P_2O_5/fed

Table (5): Effect of NP fertilization, seeding rates and varieties on fresh forage yield (ton/fed) of berseem at the different cuts in the two seasons.

Seasons	First cut		Second cut		Third cut		Fourth cut	
Treatments	2003/2004	2004/2005	2003/2004	2004/2005	2003/2004	2004/2005	2003/2004	2004/2005
Fertilization (NP)								
N1P1	3.18 b	3.48 b	5.37 b	6.42 b	4.32 b	5.40 b	3.47 b	3.79 b
N2P2	3.72 a	5.04 a	7.53 a	8.16 a	7.60 a	8.22 a	4.19 a	4.53 a
F.Test	*	*	*	*	*	*	*	*
Seeding rates (D)								
20kg/fed.	3.18 b	3.81 b	6.06 b	6.72 b	5.01 b	6.15 b	3.09 b	3.45 b
25kg/fed.	3.52 a	4.36 a	6.60 a	7.38 a	6.12 a	6.83 a	3.91 a	4.48 a
30kg/fed.	3.64 a	4.62 a	6.69 a	7.77 a	6.75 a	7.46 a	4.49 a	4.55 a
F.Test	*	*	*	*	*	*	*	*
Varieties (V)								
Meskawy	3.20 b	4.07 b	6.15 b	6. 85 b	5.42 b	6.33 b	3.32 b	4.04 a
Helaly	3.69 a	4.45 a	6.75 a	7.73 a	6.50 a	7.29 a	4.34 a	4.28 a
F.Test	*	*	*	*	*	*	*	NS
Over all treatments	3.44	4.26	6.45	7.29	5.96	6.81	3.83	4.16

* Significant at 0.05 level of probability N1P1= 40 Kg N + 15.5 kg P_2O_5 / fed, N2P2 = 80 Kg N + 31 kg P_2O_5/fed

Table (6): Effect of NP fertilization, seeding rates and varieties on dry forage yield (ton/fed) of berseem at the different cuts in the two seasons.

Seasons	First cut		Second cut		Third cut		Fourth cut	
Treatments	2003/2004	2004/2005	2003/2004	2004/2005	2003/2004	2004/2005	2003/2004	2004/2005
Fertilization (NP)								
N1P1	0.463 b	0.597 b	0.972 b	1.170 b	1.146 b	1.180 b	0.886 b	0.921 b
N2P2	0.572 a	0.697 a	1.433 a	1.531 a	1.330 a	1.807 a	1.000 a	1.131 a
F.Test	*	*	*	*	*	*	*	*
Seeding rates (D)								
20kg/fed.	0.501 b	0.583 b	1.156 b	1.219 b	1.148 b	1.366 b	0.770 c	0.857 c
25kg/fed.	0.533 a	0.665 a	1.224 a	1.393 a	1.330 a	1.498 a	0.962 b	1.099 b
30kg/fed.	0.543 a	0.693 a	1.226 a	1.439 a	1.237 a	1.617 a	1.098 a	1.122 a
F.Test	*	*	*	*	*	*	*	*
Varieties (V)								
Meskawy	0.479 b	0.610 b	1.129 b	1.271 b	1.113 b	1.381 b	0.872 b	0.984 b
Helaly	0.561 a	0.684 a	1.275 a	1.430 a	1.363 a	1.606 a	1.014 a	1.068 a
F.Test	*	*	*	*	*	*	*	*
Over all treatments	0.520	0.647	1.202	1.350	1.238	1.493	0.943	1.026

* Significant at 0.05 level of probability N1P1= 40 Kg N + 15.5 kg P_2O_5 / fed, N2P2 = 80 Kg N + 31 kg P_2O_5/fed.

Table (7): Effect of NP fertilization, seeding rates and varieties on crude protein content (%) of berseem at the different cuts in the two seasons.

Seasons	First Cut		Second Cut		Third Cut		Fourth Cut	
Treatments	2003/2004	2004/2005	2003/2004	2004/2005	2003/2004	2004/2005	2003/2004	2004/2005
Fertilization (NP)								
N1P1	18.57 b	21.14 b	18.52 b	19.83 b	16.94 b	17.66 b	14.52 b	15.74 b
N2P2	21.71 a	23.88 a	19.74 a	21.55 a	18.35 a	19.27 a	16.04 a	17.18 a
F.Test	*	*	*	*	*	*	*	*
Seeding rates (D)								
20kg/Fed.	21.06 a	24.30 a	20.04 a	22.66 a	18.84 a	20.14 a	17.16 a	17.56 a
25kg/Fed.	20.03 b	22.69 b	19.13 b	20.32 b	17.24 b	18.00 b	14.49 b	16.15 b
30kg/Fed.	19.53 b	20.55 c	18.22 c	19.11 c	16.86 b	17.24 b	14.21 b	15.68 b
F.Test	*	*	*	*	*	*	*	*
Varieties (V)								
Meskawy	18.63 b	21.35 b	18.30 b	19.94 b	16.79 b	17.29 b	14.41 b	15.60 b
Helaly	21.65 a	23.67 a	19.96 a	21.45 a	18.49 a	19.64 a	16.16 a	17.33 a
F.Test	*	*	*	*	*	*	*	*
Over all treatments	20.14	22.51	19.13	20.69	17.64	18.46	15.28	16.46

* Significant at 0.05 level of probability N1P1= 40 Kg N + 15.5 kg P_2O_5 / fed, N2P2 = 80 Kg N + 31 kg P_2O_5/fed

Table (8): Effect of NP fertilization, seeding rates and varieties on protein yield (kg/fed) of berseem at the different cuts in the two seasons.

Seasons	First cut		Second cut		Third cut		Fourth cut	
Treatments	2003/2004	2004/2005	2003/2004	2004/2005	2003/2004	2004/2005	2003/2004	2004/2005
Fertilization (NP)								
N1P1	85.98 b	126.21 b	180.01 b	232.01 b	194.13 b	208.39 b	128.65 b	144.96 b
N2P2	124.18 a	166.44 a	282.87 a	329. 93 a	244.06 a	348.21 a	160.40 a	194.31 a
F.Test	*	*	*	*	*	*	*	*
Seeding rates (D)								
20kg/Fed.	105.51 a	141.67 a	231.66 a	276.22 a	216.28 a	275.11 a	132.13 b	150.49 b
25kg/Fed.	106.76 a	150.89 a	234.15 a	283.06 a	229.29 a	269.64 a	139.39 b	177.49 a
30kg/Fed.	106.05 a	142.41 a	223.38 a	274.99 a	208.56 a	278.77 a	155.92 a	175.93 a
F.Test	NS	NS	NS	NS	NS	NS	*	*
Varieties (V)								
Meskawy	89.24 b	130.24 b	206.61 b	253.44 b	186.87 b	238.77 b	125.65 b	153.50 b
Helaly	121.45 a	161.90 a	254.49 a	306.73 a	252.02 a	315.42 a	163.86 a	185.08 a
F.Test	*	*	*	*	*	*	*	*
Over all treatments	105.59	145.68	230.45	279.48	218.74	276.33	143.71	168.82

* Significant at 0.05 level of probability N1P1= 40 Kg N + 15.5 kg P_2O_5 / fed, N2P2 = 80 Kg N + 31 kg P_2O_5/fed.

Table (9): Effect of NP fertilization, seeding rates and varieties on total fresh forage yield (ton/fed), total dry forage yield (ton/fed) and total protein yield (Kg/fed) of berseem during the two seasons and the combined data.

Seasons	Total fresh forage yield (ton/fed)			Total dry forage yield (ton/fed)			Total protein yield (Kg/fed)		
Treatments	2003/2004	2004/2005	Comb.	2003/2004	2004/2005	Comb.	2003/2004	2004/2005	Comb.
Fertilization (NP)									
N1P1	16.34 b	19.09 b	17.71 B	3.47 b	3.87 b	3.67 B	588.77 b	711.57 b	650.17 B
N2P2	23.04 a	25.95 a	24.49 A	4.33 a	5.17 a	4.75 A	811.51 a	1038.89 a	925.20 A
F.Test	*	*	*	*	*	*	*	*	*
Seeding rates (D)									
20kg/Fed.	17.34 b	20.13 b	18.73 B	3.57 b	4.02 b	3.79 B	685.58 a	843.49 a	764.53 A
25kg/Fed.	20.15 a	23.05 a	21.60 A	4.05 a	4.65 a	4.35 A	709.59 a	881.08 a	795.33 A
30kg/Fed.	21.57 a	24.40 a	22.98 A	4.10 a	4.87 a	4.48 A	693.91 a	872.10 a	783.00 A
F.Test	*	*	*	*	*	*	NS	NS	NS
Varieties (V)									
Meskawy	18.09 b	21.29 b	19.69 B	3.59 b	4.25 b	3.92 B	608.37 b	775.95 b	692.16 B
Helaly	21.28 a	23.75 a	22.51 A	4.21 a	4.79 a	4.50 A	791.82 a	969.13 a	880.47 A
F.Test	*	*	*	*	*	*	*	*	*
Over all treatments	19.68	22.52	21.10	3.90	4.52	4.21	698.51	870.32	784.41

* Significant at 0.05 level of probability N1P1= 40 Kg N + 15.5 kg P_2O_5 / fed, N2P2 = 80 Kg N + 31 kg P_2O_5/fed

Data in Table (8) indicate that seeding rates did not exert significant effect on protein yield/fed in all cuts during both seasons except the fourth cut where 30 kg seed/fed gave significant increase in protein yield/fed compared to 20 kg seed/fed in the two seasons (Table 8).

Helaly cv. significantly outyielded Meskawy cv. in protein yield/fed in all cuts during the two seasons. This result may be due to that Helaly cv. gave significant increases in crude protein content (%) and dry forage yield/fed compared to Meskawy cv. These results are in accordance with those reported by Ramadan *et al.* (1994) and Gaballah (2001).

Over all treatments, the second cut outyielded third, fourth and first cuts, respectively for protein yield/fed in both seasons.

9-Total fresh, dry forage and protein yields/fed:-

Data in Table (9) show that increasing NP fertilizer level from 40 Kg N + 15.5 kg P_2O_5/fed to 80 Kg N + 31 kg P_2O_5/fed significantly increased total fresh and dry forage yields/fed as well as protein yield/fed in the two seasons and over them. Applying 80 Kg N + 31 kg P_2O_5/fed outyielded 40 Kg N + 15.5 kg P_2O_5/fed in total fresh forage yield/fed by 41.00%, 35.93% and 38.28%, in total dry forage yield/fed by 24.78%, 33.59% and 29.43% and in total protein yield/fed by 37.83%, 45.99% and 42.30% in the two seasons and over them, respectively. The positive effect of increasing NP fertilizer on total fresh and dry forage yields/fed of berseem was expected since nitrogen and phosphorus are a constituent of many organic compounds in plants, enhance cell division, meristematic activity and metabolism processes such as photosynthesis, synthesis of protein, carbohydrates and lipids. Moreover, phosphorus stimulates root growth and in turn increases efficiency of absorbing nutrients from soil as well as favours nodulation and N fixation. For these reasons, NP fertilizers stimulated vegetative plant growth such as plant height and number of branches/plant as well as dry matter accumulation in leaves and stems of plant, finally increased total fresh and dry forage yields/fed. Similar results were reported by Shaaban *et al.* (1984), Zagloul (1995) and Aly (1999). While, the increase in protein yield/fed due to increasing NP fertilizers might be attributed to their favourable effects on crude protein content (%) and dry forage yield/fed. These results are in harmony with those reported by El-Sheikh (1986), Zagloul (1995) and Ali *et al.* (1997).

It is clearly evident from Table (9) that total fresh and dry forage yields/fed were significantly increased by increasing seeding rate from 20 to 25 kg/fed, but increasing seeding rate up to 30 kg/fed gave insignificant increases as compared to 25 kg/fed in the mentioned characters. That was true in the two seasons and over them. Increasing seeding rate from 20 to 25 and 30 kg/fed increased total fresh forage yield/fed by 16.21% and 24.39% in 3003/2004 season, 14.51% and 21.21% in 2004/2005 season and 15.32% and 22.69% in the combined data, respectively. The respective relative increases for total dry forage yield/fed were 13.44% and 14.85% in the first season, 15.67% and 21.14% in the second season and 14.78% and 18.21% in over them, respectively. The increases in total fresh and dry forage yields/fed by increasing seeding rate might be due to rapid and even soil covering at higher seeding rate which in turn resulted in more effective use of growth factors such as space, moisture, nutrients and light. Also, greater number of plants per unit area of land could compensate the reduction in growth of individual plants such as number of branches/plant. It is with great importance that the unit land area not the individual plant, produces its maximum yield. It could be concluded from these results that the most suitable seeding rate for berseem in sandy soils of Ismailia governorate under sprinkler irrigation system is 25 Kg seed/fed. These results are in accordance with those obtained by Hussein *et al.* (1983), Shaaban *et al.* (1984), Aly (1989) and Sarhan & Abd El-Maksoud (2002)..

Also, the highest total protein yield/fed was recorded for 25 kg seed/fed followed by 30 kg/fed, while 20 kg/fed ranked the last one, but the differences among the three seeding rates were not significant in the two seasons and over them (Table 9).

Helaly cv. significantly surpassed Meskawy cv. in the total fresh and dry forage yields/fed as well as total protein yield/fed in the two seasons and their combined averages (Table 9). Helaly cv. outyielded Meskawy cv. in total fresh forage yield/fed by 17.63%, 11.55% and 14.32%, in total dry forage yield/fed by 17.27%, 12.71% and 14.79% and in total protein yield/fed by 30.15%, 24.89% and 27.21% in the two seasons and over them, respectively. The superiority of Helaly cv. in its total fresh and dry forage yields/fed may be due to its higher number of branches/plant as well as accumulation of dry matter. While, high total protein yield/fed which was achieved by Helaly cv. might be attributed to its higher total dry forage yield/fed and crude protein content (%). Confirming results were reported by Abd El-Halim *et al.* (1993), Ramadan *et al.* (1994), Ahmed and Mohamed (1995), Gaballah (2001) and Sarhan and Abd El-Maksoud (2002).

Interactions effect:-

The statistical analysis of variance revealed that the all possible interactions among the three studied factors did not had any significant effects on all studied characters in both seasons.

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إستجابة صنفين من البرسيم المصرى للتسميد الآزوتى والفوسفاتى ومعدلات التقاوى فى الأراضى الرملية حديثة الاستصلاح تحت نظام الرى بالرش

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أجريت تجربتان حقليتان بمزرعة كلية الزراعة- جامعة قناة السويس بالإسماعيلية خلال الموسمين الزراعيين ٢٠٠٣/٢٠٠٤ و ٢٠٠٤/٢٠٠٥ بهدف دراسة تأثير معدلين من التسميد الآزوتى والفوسفاتى (٤٠ كجم أزوت + ١٥,٥ كجم فو٢أ٥/فدان و ٨٠ كجم أزوت + ٣١ كجم فو٢أ٥/فدان) و ثلاثة معدلات من التقاوى (٢٠، ٢٥ ، ٣٠ كجم بذور/فدان) على صفات النمو ومحصول العلف الأخضر والجاف/فدان والنسبة المئوية للبروتين الخام و محصول البروتين/فدان لصنفين من البرسيم المصرى (المسقاوى و الهلالى) فى الأراضى الرملية بمحافظة الإسماعيلية تحت نظام الرى بالرش.
ويمكن تلخيص النتائج كما يلي:-

١. أدت زيادة معدل التسميد الآزوتى والفوسفاتى من ٤٠ كجم أزوت + ١٥,٥ كجم فو٢أ٥ /فدان إلى ٨٠ كجم أزوت + ٣١ كجم فو٢أ٥ /فدان إلى زيادة معنوية فى ارتفاع النبات و عدد الأفرع/ نبات ومحصول العلف الأخضر والجاف/فدان والنسبة المئوية للبروتين الخام و محصول البروتين/فدان في جميع الحشات وكذلك محصول العلف الأخضر والجاف و البروتين الكلى/فدان خلال موسمي الدراسة.
٢. أدى تقليل معدل التقاوى من ٣٠ كجم إلى ٢٠ كجم/ فدان إلى زيادة معنوية فى كل من عدد الأفرع / نبات ونسبة الوزن الأخضر والجاف للأوراق/السيقان والنسبة المئوية للبروتين الخام. بينما أدى زيادة معدل التقاوى من ٢٠ كجم إلى ٢٥ كجم / فدان إلى زيادة معنوية في ارتفاع النبات ومحصول العلف الأخضر والجاف / فدان في جميع الحشات وكذلك محصول العلف الأخضر والجاف الكلى/فدان خلال موسمى الدراسة.
٣. تفوق الصنف هلالى معنويا على الصنف المسقاوى في كل من محصول العلف الأخضر والجاف / فدان والنسبة المئوية للبروتين الخام و محصول البروتين/فدان في كل الحشات ومحصول العلف الأخضر والجاف و البروتين الكلى/فدان خلال موسمي الدراسة. وكذلك عدد الأفرع/ نبات في الحشة الثانية في كلا الموسمين.
٤. يمكن الحصول على أعلى محصول علف أقتصادى من البرسيم المصرى في الأراضي الرملية بمحافظة الإسماعيلية تحت نظام الرى بالرش بزراعة الصنف هلالى بمعدل تقاوى ٢٥ كجم بذور/ فدان والتسميد بمعدل ٨٠ كجم أزوت + ٣١ كجم فو٢أ٥ /فدان.