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MAIZE FOR GRAIN AND FODDER UNDER DIFFERENT SEEDING RATES AND N LEVELS

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ABSTRACT: ***Maize response to seven thinning treatments at 105, 120 and 135 kg/fed. N levels was conducted at Agriculture Research Station, Alexandria University during 2006 and 2007 summer seasons.***

Thinning treatments were sowing with 12 kg/fed seeding rate then thinning to one plant/hill at 25 cm intraspacing after 21 days from sowing (M_0) and at (1) 50, (2) 60 or (3)70 days after sowing to formulate either M_{11}, M_{12} and M_{13} with 18 kg/fed seeding rate (M_1) or M_{21}, M_{22} or M_{23} treatments with seeding rate of 24 kg/fed (M_2).

Increasing the nitrogen level from 105 to 135 kg/fed. significantly increased forage yield/fed., plant height, ear leaf area, number of grains/ear, grain weight/ear and grain yield/fed.

Thinning of M_0 treatment gave the greatest ear-leaf area, ear grain weight, 100-grain weight and grain yield/fed., whereas lowest values were with M_{23} treatment and vice versa for forage yield and plant and ear heights.

Grain yield response was linear to increasing N level with b values, amounting to 0.084 and 0.092 ardab/fed. in 2006 and 2007, respectively. Correlation analysis indicated that grain yield was positively and significantly correlated with ear-grain weight, ear-leaf area, 100-grain weight and number of grains/ear with corresponding values of 0.709, 0.743, 0.964 and 0.437 in 2006 season, and 0.967, 0.824, 0.917 and 0.957 in 2007 season.

Key Words***: Maize (Zea mays L.), Plant density, thinning treatments, grain yield.***

INTRODUCTION

Plant population density (PPD) and nitrogen fertilization level are two important factors affecting the potentiality of any crop productivity. PPD affects post flowering source/sink ratio through its effects on plant leaf number, ear leaf area, the amount of light intercepted and kernel number per plant (Borras *et al*., 2003 and Subedi *et al*., 2006). All values of these traits decreased in response to increased plant population density. Borras *et al*. (2003) reported that increased PPD promoted an enhanced light attenuation within the canopy and increased post flowering source/sink ratio. The PPD ultimately affects yield via altering yield components (Subedi *et al*., 2006) where when it is high, there is an abortion of ear and kernels due to interplant competition for assimilates during the flowering period, coupled with the association of a reduction in number of kernels per ear, mean kernel

weight and cob length (Westage *et al*., 1997, Andrade *et al*., 1999 and Tollenar and Wu, 1999).

Nitrogen fertilizer affects maize dry matter production by influencing leaf area development and maintenance, in addition to photosynthetic efficiency (Gardner *et al*., 1985, Muchow and Davis, 1988, Mc Cullough *et al*., 1994, Uhart and Andrade, 1995 and Muchow, 1998) and consequently grain yield (Subedi *et al*., 2006).

Increase in plant height with increasing N levels may be attributed to N-stimulating effect on the internode enlongation through meristematic activity during vegetative period. Also, nitrogen supply causes an increase in leaf number and ear-leaf area (Lemcoff and Loomis, 1985; Cox *et al*., 1993 and Nawar, 2004) that could be likely due to increases in cell division, e.g. length and width dimensions. Yield and its attributes, i.e. number of grains/ear, ear grain weight and individual grain weight had been proportionally influenced by N application (Gouda and El-Banna, 1995, Selim and Gouda, 1998, Nawar, 2004 and Subedi *et al*., 2006).

Most of the Egyptian maize growers delay thinning, being applied at intervals, to obtain a source of green fodder as a premium for cattle during the summer season since the fresh forage is scarce. Gelilah (1983) and Faisal *et al*. (1993) found that delay in thinning to one plant/hill before the first irrigation was the best practice for obtaining the highest values for plant and ear heights as

well as grain yields per plant and per feddan. Meanwhile Liu and Chen (1982) found that thinning before the 4 or/after the 6-leaf stage restricted ear and plant heights, however, the reverse was obtained at the stage of 5-leaves.

Although the need for N is related with the purpose of crop production, studies on N rates with different PPD for maize sown as a dual purpose crop (grains and forage) are limited. This investigation was conducted to study the response of maize to N level under different seeding rates with delay in thinning dates.

MATERIALS AND METHODS

Studying the response of maize (3-way cross, G.310) growth aspects to 105 (=N_1), 120 (=N_2) and 135 (=N_3) kg N/fed. under seven thinning treatments was conducted at Agriculture Research Station, Alexandria University during 2006 and 2007 summer seasons. Soil chemical characters were pH = 8.4, organic matter (%) = 1.20, total N (%) = 0.017 and available phosphorus (inorganic, ppm) = 2.70, as an average of both seasons. Thinning treatments were: 1- M_0: sowing on one side of ridge with 12 kg/fed seeding rate and thinning to one plant/hill (spaced at 25 cm apart) 21 days after sowing (DAS) at the first irrigation and 2-thinning to the standard population at (1) 50, (2) 60 or (3) 70 DAS to formulate thinning treatments of M_{11}, M_{12} and M_{13} in case of

18 kg/fed. seeding rate (M_1) and M_{21}, M_{22} and M_{23} for the rate of 24 kg/fed (M_2).

A split plot design with three replicates was used in both seasons. The main plots were assigned to the three nitrogen levels and the sub plots were allocated to the six thinning treatments beside control. Each experimental unit comprised 5 ridges, each 3 m long and 0.7 m wide. Sowing dates were May 15 and 20 during the two successive seasons. Nitrogen, as ammonium nitrate (33.5%), was added in two equal doses at first and second irrigations. Other agricultural practices were uniformly applied according to recommendations.

Forage yield per feddan was calculated as the weight of the thinned plants from the inner three ridges then converted to ton per feddan. Plant height (cm), ear height (cm), number of leaves/plant and ear-leaf area (cm^2) were measured as the average of 10 guarded plants taken at random from each subplot. A sample of 5 ears, taken at random from each sub plot, was used to estimate number of grains/ear and ear grain weight (g). One hundred grain weight (g) was calculated as the average of 3 samples taken from each sub plot. Grain yield/fed. (kg) was calculated from the 3 inner ridges of each plot, then converted to ardab/fed. (one feddan= 0.42 ha, ardab = 0.14 ton).

Statistical analysis was applied according to Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Analysis of variance (Table 1) revealed the significant effects of N fertilization levels on all the studied characters except ear height, number of leaves/plant and 100-grain weight during the two seasons. Of these characters, forage yield, plant and ear heights, ear leaf area and ear grain weight, 100-grain weight in addition to grain yield/fed. significantly responded to thinning treatments over the two seasons. N level × thinning treatment interactions were significant for forage yield in both seasons in addition to plant height and ear grain weight only in the first season.

Forage yields were greatest at 135 and lowest with 105 kg N/fed. in both seasons (Tables 2 and 3), indicating the vital role of N in plant growth. Plant dependence on N for photosynthesis, cell division and merstematic activity was responsible for high forage productivity from maize healthy and vigorous plants. Estimations for forage yields, as affected by N application, indicated that N_3 level produced 0.59 and 1.83 t/fed. (averaged over the two seasons) higher than that of N_2 and N_1 levels, respectively.

Differences in plant height (Tables 2 and 3) were significant between N_3 and both N_1 and N_2 and insignificant between N_1 and N_2 levels in the two seasons. Plants of 135 kg N plots exceeded those of 105 kg N by an average of 12.5 cm. Reason for plant height increase was probably due to the stimulatory effect of N on the internode enlongation in due to more meristematic activity during vegetative growth stage. These results accorded with those reported of Selim and Gouda (1998).

Table 1

Ear leaf area (Tables 2 and 3) response was proportional to the rate of N. The greater the N applied, the higher the ear-leaf area obtained. Which might be attributed the enhancing effect of N on leaf cell division, in addition to increases in leaf length and width dimensions. Over the two seasons, the average increases amounted to 79.29 and 19.21 cm^2 at 135 kg N/fed., relative to 105 and 120 kg N/fed., respectively.

Increasing the N level up to 135 kg/fed. produced the highest grain number/ear compared to the lowest N level of 105 kg N/fed. Comparing with N_2 and N_1, the N_3 level gave more number of grains/ear that was estimated to 30.88 and 88.57 grains, as an average of the two seasons, respectively. Nevertheless increasing N level above 120 kg/fed. gave insignificant increases in that trait during the two seasons. These results could be explained by the increase in spikelet fertility as influenced by an adequate supply of N which enhances the photosynthetic capacity of the plant and provides higher amounts of photosynthates that are translocated to the fertilized ovaries to initiate grain formation (Jacobs and Pearson, 1990).

Concerning ear grain weight, the highest N level of 135 kg/fed. produced the heaviest ear grain weight. Superiority for N_3 level to N_2 and N_1 levels was estimated, as the average of both seasons, at 19.68 and 42.18 g/ear, respectively, while the difference between N_2 and N_1 was 22.50 g/ear. These results may be attributed to a lower number of grains/ear of N_1 and N_2 plants compared to N_3 level. Jacobs and Pearson (1990) and Uhart and Andrade (1995) reported that inadequate N supply was responsible for reductions in grain weight and number and consequently in grain weight/ear. These results agreed with Selim and El-Sergany (1995) who reported that increases in N level were associated with increases in ear weights.

Grain yield/fed. followed the same trend of yield attributes, i.e. number of grains/ear, and ear grain weight with regard to nitrogen application over the two seasons. The highest yields were obtained from plots fertilized with 135 kg N/fed. and surpassed the lowest and intermediate levels by 3.08 and 2.04 ardab/fed., as an average of the two seasons. These results were in accordance with Jacobs and Pearson (1990); Uhart and Andrade (1995) and Selim and Gouda (1998). Partitioning the effect of nitrogen on grain yield into linear and quadratic, the response was evident to be linear, in both seasons, and the equations were as follows :

$$\hat{Y} = 3.90 + 0.084\,x \quad (R^2 = 0.81) \quad \text{in 2006 season}$$

$$\hat{Y} = 4.82 + 0.092\,x \quad (R^2 = 0.92) \quad \text{in 2007 season}$$

The equations indicated that increases in nitrogen by unity was associated with yield increases that amounted to 0.084 and 0.092 ardab/fed. in the two successive seasons, respectively. Also, the linear response would

suggest that higher doses of nitrogen fertilizer in this study should be investigated in order to determine the optimum level of nitrogen needed for maize.

Regarding thinning procedure, forage yields were affected by seeding rate and time of thinning (Tables 2 and 3). Seeding rate of 24 kg/fed. with thinning 70 DAS produced the highest forage yields over the two seasons. Forage yield of M_{23} was 8.96 and 8.86 ton greater than those of M_{11} in the two successive seasons.

Concerning plant height, M_0 plots had the shortest plants, while the tallest ones were obtained from M_{23} plots (Tables 2 and 3). As shown from data, plant heights were influenced by periods to thinning and seeding rate, where they increased with increasing seeding rate and delaying of thinning. In M_0 treatment, light in uniform distribution within maize canopy made plants avoid shade effect, etiolation or internode, enlongation, especially at early growth stages thus they were the shortest in plant height (Gardner *et al*., 1985; Loomis and Coonor, 1985 and Kagho and Gardner, 1988). In addition, the two seasons average indicated that plant heights were calculated to be 200.22 for M_0, 222.72 for (M_{11} + M_{12} + M_{13}) and 236.89 cm for (M_{21} + M_{22} + M_{23}), indicating that increasing seeding rate and delay thinning more than 21 days increased plant height.

Ear height on maize stalk plants (Tables 2 and 3) followed the plant height course of change during the two seasons. Thinning 21 DAS (M_0) produced the lowest ear height whereas the highest estimate for such trait was obtained from M_{23} treatment. Insignificant differences were found among other thinning treatments. Consequently, it may be suggested that increasing period to thinning with higher seeding rate was responsible for higher ear position and plant heights. These results were in agreement with Liu and Chen (1982) and Faisal *et al*. (1993) who reported that thinning at early stages of growth produced shorter plants and lower ears placement.

Thinning treatments exhibited different variations for ear leaf area (Tables 2 and 3). Maize plants of M_0 plots possessed the largest ear-leaf area, however those of M_{23} had the lowest ear leaf area during the two seasons. Increases in ear leaf area for M_0 were 110.80 and 124.62 cm^2 greater than their corresponding values of M_{23} during the two seasons, respectively. Kagho and Gardner (1988) reported similar results which indicated that maize optimum population with equidistant plant spacing produced the greatest ear leaf area.

Ear grain weight means (Tables 2 and 3) showed that the M_{23} exhibited the least weight of grains/ear, in contrast with M_0 which produced the greatest effect over the two seasons. Decreases of ear-grain weight in M_{23}, as an average of the two seasons, were respectively 59.45 and 86.11 g relative to M_{11} and M_0 treatments. The short duration from thinning to maturity in M_{23} (thinning at 70 DAS) enabled the plants to compensate for the reductions in

water and nutrients uptake due to the high intraplant competition resulting from high population density before thinning.

Table 2

Table 3

Consequently, reductions in spikelets number and fertility, in addition to grain weight, led to the decrease in ear-grain weight. These results were in accordance with Prior and Russell (1975) and Baenzign and Glover (1980) who reported increases in ear grain weight with plant population decrease.

One hundred-grain weight responses to thinning treatments (Tables 2 and 3) were largest for M_0, intermediate for M_{11} and lowest for M_{12}, M_{13}, M_{21}, M_{22} and M_{23}. Increases in 100-grain weight averaged 9.20 and 7.32 g for M_0 and M_{11}, respectively, relative to M_{23} treatment. That may be attributed to greater leaf area in M_0 and M_{11} populations resulting in higher assimilate production and translocation to the developing grains. Jacobs and Pearson (1990) reported that the increase in ear leaf area, which is the shortest assimilate translocation pathway to the grain, was responsible for the heaviest grain weight.

Responses of maize grain yield/fed. to thinning treatments were similar in both seasons. The average increases of grain yield for M_0 were 14.93 and 1.40 ardab/fed., relative to M_{23} and M_{11} treatments, respectively. Grain yield superiority of M_0, compared to other treatments, may be attributed to the increase in kernel weight. These results were in accordance with Faisal *et al*. (1993) who reported that thinning of maize 21 DAS produced the highest grain yield/fed. and that delayed thinning practices decreased yield.

The variation between thinning treatments in number of leaves/plant and number of grains/ear did not reach the level of significance in both seasons (Tables 2 and 3).

The first order interaction (Table 4) indicated that the forage yield/fed. increased with increasing both seeding rates and period from sowing to thinning, at the same N level and also by increasing N-level at the same thinning treatment (in both seasons). The M11 x N1 interaction resulted in the lowest forage yields (1.4 and 1.53 t/fed., in the two successive seasons) while that of M_{23} x N_3 produced the highest forage yield (11.34 t/fed. as an average of the two seasons). The interaction effect resulted from the magnitude of increase in forage yield from M_{11} to M_{12} and M_{21} to M_{22} compared to that from M_{12} to M_{13} and M_{22} to M_{23}, in both seasons.

Table (4), also revealed that plant height responded differently to N level at the same thinning treatment, in addition to thinning treatment at the same N level (in 2006 season only). Therefore, the tallest plant height was obtained from M_{23} and N_3 combination, however, the combined effect of M_0 and both N_1 or N_2 produced the lowest estimates of plant height. The interaction effect resulted from the magnitude of increase in plant height from N_1 to N_2 compared to that from N_2 to N_3 at the different thinning treatments.

On the other hand, Table (4) data showed that use 18 of or 24 kg/fed. seeding rates with 70, compared to50 or 60 DAS at the same N-level caused a reduction in grain weight/ ear during 2006 season. Increasing N level at the

same thinning period increased ear-grain weight, being highest or lowest with $N_3 \times M_0$ and $N_1 \times M_{23}$, respectively.

Table 4

Interception as much solar energy as possible with equidistant in addition to thinning at 21 DAS, before the first irrigation, and 135 kg N/fed. increased photosynthetic rate, photoassimilates translocation to grains and consequently ear grain weight (Gardner *et al*., 1985, Lemcoff and Loomis, 1985). The variations in reduction of ear grain weight with delaying of thinning, at the same N level and seeding rate, resulted in the significance of the interaction effect.

Simple correlation coefficients (Table 5) indicated that grain yield/fed. of maize was significant and positively correlated with ear-leaf area and all yield components, i.e. ear grain weight, 100-grain weight and number of grains/ear, in both seasons. On the other hand, it was negatively and significantly correlated with both ear and plant heights. Ear-grain weight followed the same trend as grain yield/fed. Ear –leaf area was positively and significantly correlated with 100-grain weight and number of grains/ear, while it was negatively and significantly correlated with both ear height and plant height.

Table (5): Correlation coefficients between some studied characters in 2006 and 2007 seasons.

Characters	Grain yield/fed.		Ear-grain weight		Ear leaf area	
	2006	2007	2006	2007	2006	2007
Ear grain weight	0.709*	0.967*				
Ear-leaf area	0.743*	0.824*	0.564*	0.848*		
100-kernel weight	0.964*	0.917*	0.793*	0.953*	0.740*	0.585*
Number of grains/ear	0.437*	0.957*	$0.206^{n.s}$	$0.327^{n.s}$	0.702*	0.723*
Number of leaves/plant	$0.354^{n.s}$	$0.301^{n.s}$	0.509*	0.523*	$0.367^{n.s}$	$0.405^{n.s}$
Ear height	- 0.688*	- 0.709*	- 0.778*	- 0.812*	- 0.813*	- 0.863*
Plant height	- 0.775*	- 0.787*	- 0.889*	- 0.882*	- 0.858*	- 0.869*

*** Significant at 0.05 probability level.**

It could be concluded that, although maize grain yield was significantly reduced in the combination of maize for grains and maize for forage compared to maize for grains only, the first combination (M_{11}) may be recommended because it provides essential need of forage in the summer season for the farmer. In addition, the economic evaluation of both treatments (M_o and M_{11}) revealed that there was a slight decrease in the economic value of the combination, however, the benefit gained from the animal production point of view may justify the recommendation of that combination.

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زراعة الذرة كمصدر للحبوب والعلف تحت معدلات تقاوى ونيتروجين مختلفة

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الملخص العربي

أجريت تجربتان حقليتان خلال موسمىّ ٢٠٠٦ و ٢٠٠٧ بمحطة البحوث الزراعية – جامعة الإسكندرية ، لدراسة إستجابة محصول الذرة الشامية لسبع معاملات من الخف وثلاثة مستويات من التسميد النتروجينى (١٠٥ ، ١٢٠ و ١٣٥ كجم ن / فدان) ، وتم إجراء الخف كما يلى :

١- M_0 : زراعة الذرة بمعدل تقاوى = ١٢ كجم/فدان على مسافات ٢٥سم بين الجور ، خفت بعد ٢١ يوم من الزراعة على نبات واحد بكل جورة ليصبح عدد النباتات ٢٤ ألف / فدان .

٢- الخف إلى ٢٤ ألف نبات/فدان بعد ٥٠ أو ٦٠ أو ٧٠ يوم من الزراعة لتكون معاملات الخف على التوالى :

أ) M_{11} ، M_{12} و M_{13} عندما أستخدم معدل من التقاوى = ١٨ كجم/ فدان .

ب) M_{21} ، M_{22} و M_{23} عندما أستخدم معدل من التقاوى = ٢٤ كجم/ فدان .

أدت زيادة مستوى التسميد النتروجينى من ١٠٥ إلى ١٣٥ كجم نتروجين/فدان إلى زيادة معنوية فى محصول العلف الأخضر (طن/فدان)، طول النبات (سم)، مساحة ورقة الكوز (سم^2)، عدد حبوب الكوز، وزن حبوب الكوز (جرام) ومحصول الحبوب (أردب/فدان).

أعطت معاملة الخف M_0 أعلى القيم بينما أعطت المعاملة M_{23} أقل القيم لصفات مساحة ورقة الكوز، وزن حبوب الكوز، وزن ١٠٠ حبة ومحصول الحبوب/فدان والعكس صحيح لصفات محصول العلف الأخضر / فدان وإرتفاع كل من النبات والكوز على النبات .

أوضحت النتائج وجود إستجابة خطية بين محصول الحبوب ومستوى التسميد النتروجينى حيث أدت زيادة معدل السماد النتروجينى بمقدار ١ كجم نتروجين/فدان إلى زيادة فى محصول الحبوب تبلغ ٠.٠٨٤ ، ٠.٠٩٢ أردب/فدان خلال الموسمين على التوالى.

وقد أظهر تحليل التلازم بين الصفات المدروسة وجود علاقة موجبة ومعنوية بين محصول الحبوب وكل من وزن حبوب الكوز ، مساحة ورقة الكوز، وزن ١٠٠ حبة وعدد حبوب الكوز. وكانت قيم معاملات التلازم المقابلة لهذه الصفات ٠.٧٠٩ ، ٠.٧٤٣ ، ٠.٩٦٤ و ٠.٤٣٧ خلال الموسم الأول و ٠.٩٦٧ ، ٠.٨٢٤ ، ٠.٩١٧ و ٠.٩٥٧ خلال الموسم الثانى.

Table (1): Analysis of variance of the studied traits of maize during 2006 and 2007, seasons.

S.O.V.	d.f.	Forage yield	Plant height	Ear height	Number of leaves/plant	Ear leaf area	Number of grains/ear	Ear-grain weight	100-grain weight	Grain yield/fed.
2006										
Nitrogen rates (A)	2 (2)[(1)]	*	*	n.s	n.s	*	*	*	n.s	*
Error a	4 (4)	0.37	26.64	3.35	1.54	1630.00	836.68	148.21	5.73	1.54
Thinning treatments (B)	6 (5)	*	*	*	n.s	*	n.s	*	*	*
A × B	12 (10)	*	*	n.s	n.s	n.s	n.s	*	n.s	n.s
Error b	36 (30)	0.45	21.33	6.31	2.37	2354.10	1371.24	82.74	5.35	1.86
2007										
Nitrogen rates (A)	2 (2)	*	*	n.s	n.s	*	*	*	n.s	*
Error a	4 (4)	0.42	25.81	16.20	1.33	696.34	3907.11	148.21	20.10	3.26
Thinning treatments (B)	6 (5)	*	*	*	n.s	*	n.s	*	*	*
A × B	12 (10)	*	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s
Error b	36 (30)	0.47	23.50	4.97	1.62	1568.78	1254.39	110.10	15.22	1.24

(1) Degrees of freedom for forage yield are given between parenthesis.
* Significant at 0.05 level of probability.
n.s. not significant.

Table (2): Means of some traits as affected by nitrogen fertilization related to thinning treatments during 2006 season.

Treatments	Forage yield ton/fed.	Plant height (cm)	Ear height (cm)	Number of leaves/plant	Ear leaf area (cm^2)	Number of grains/ear	Ear grain weight (g)	100-grain weight (g)	Grain yield ardab/fed.
Nitrogen level (kg/fed.)									
N_1 = 105	6.14	218.66	87.18	15.80	552.16	367.14	111.90	32.95	12.84
N_2 = 120	7.17	222.24	88.39	15.61	619.18	409.52	131.90	33.14	13.74
N_3 = 135	8.06	230.14	88.49	15.59	627.45	430.22	149.10	34.61	15.35
$LSD_{0.05}$	0.52	4.35	n.s	n.s	34.59	24.78	10.42	n.s	1.06
Seeding and thinning treatments									
M_0	-	198.22	78.80	15.97	639.13	400.20	183.33	40.81	21.43
M_{11}	2.24	221.82	83.03	15.26	611.28	400.64	156.67	39.70	19.88
M_{12}	7.87	221.81	83.48	15.98	610.29	380.12	128.10	32.30	13.06
M_{13}	9.69	221.43	85.89	15.24	610.82	406.28	128.90	31.11	8.54
M_{21}	3.04	223.67	87.44	15.48	607.89	406.24	133.33	31.76	17.63
M_{22}	8.70	224.41	87.44	15.90	560.59	399.51	108.90	31.46	10.38
M_{23}	11.20	259.09	107.71	15.02	528.33	421.06	92.23	30.82	8.04
$LSD_{0.05}$	1.10	3.49	4.80	n.s	68.62	n.s	6.71	1.92	1.40

n.s : not significant at 0.05 level of probability.

Table (3): Means of some traits as affected by nitrogen fertilization related to thinning treatments during 2007 season.

Treatments	Forage yield ton/fed.	Plant height (cm)	Ear height (cm)	Number of leaves/plant	Ear leaf area (cm^2)	Number of grains/ear	Ear grain weight (g)	100-grain weight (g)	Grain yield ardab/fed.
Nitrogen level (kg/fed.)									
N_1 = 105	5.92	220.57	87.00	16.80	557.39	373.53	116.90	29.98	14.25
N_2 = 120	7.37	224.92	87.30	17.61	610.52	446.53	141.90	28.85	15.44
N_3 = 135	7.66	234.07	87.30	17.59	640.67	487.59	164.05	30.57	17.90
$LSD_{0.05}$	0.56	4.42	n.s	n.s	22.60	53.55	10.43	n.s	1.55
Seeding and thinning treatments									
M_0	-	202.22	80.02	17.97	653.89	150.29	193.33	36.03	25.30
M_{11}	2.14	223.66	85.78	17.26	621.78	150.24	166.67	33.37	24.06
M_{12}	7.77	224.11	85.08	16.98	605.78	141.03	138.89	28.20	13.82
M_{13}	9.59	223.49	87.24	17.24	596.44	141.13	118.89	27.76	9.51
M_{21}	2.94	226.33	87.80	17.48	645.44	143.61	143.33	28.17	18.38
M_{22}	8.46	227.74	88.36	16.90	597.00	141.29	113.33	27.39	11.13
M_{23}	11.00	260.07	105.69	17.52	529.27	139.48	112.22	27.62	8.83
$LSD_{0.05}$	1.19	4.67	3.67	n.s	38.13	n.s	10.11	4.60	1.07

n.s : not significant at 0.05 level of probability.

Table (4): Two factor interactions for forage yield, in both seasons, in addition to plant height and ear grain weight in 2006 season.

Factors	Forage yield (ton/fed.)						Plant height (cm)			Ear grain weight (g)		
	2006			2007			2006			2006		
	N_1	N_2	N_3	N_1	N_2	N_3	N_1	N_2	N_3	N_1	N_2	N_3
M_0	-	-	-	-	-	-	193.23	193.80	202.67	170.00	186.67	193.33
M_{11}	1.50	2.24	2.88	1.53	2.30	2.79	204.53	206.70	213.20	140.00	160.00	170.00
M_{12}	6.70	7.87	8.95	6.40	8.23	8.42	214.30	217.50	217.50	113.00	126.67	156.67
M_{13}	7.83	9.69	11.28	7.53	11.65	10.24	218.63	219.13	231.53	80.00	106.67	140.00
M_{21}	2.80	3.04	3.41	2.87	3.23	3.29	221.30	226.40	227.30	103.33	130.00	156.67
M_{22}	7.40	8.70	9.88	6.90	8.83	9.59	233.80	233.20	234.30	96.67	120.00	123.33
M_{23}	10.60	11.20	11.95	10.30	11.37	11.65	246.13	260.93	289.53	80.00	93.00	103.33
$LSD_{0.05}$	1.10			0.64			6.04			11.62		