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EFFECT OF NITROGEN AND PHOSPHORUS FERTILIZERS, SOWING DATES AND ROW SPACING ON GROWTH AND YIELD OF *Dolichos lablab*.L.

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ABSTRACT

The present study was conducted to evaluate the effect of four levels of fertilizer combinations of urea(46%N) and triple superphosphate (46% p_2o_5) ,three row spacing (20-30- and 40cm)to give plant densities of (50 ,38 and 25 plants/sq m. respectively) and three sowing dates (15 March, 15 April and 15 May)during(2000-2001) seasons on vegetative growth and yield of *Dolichos lablab*.L plant.

The application of nitrogen and phosphorus fertilizers in rate of 10 g N/sq. m +20 g p_2o_5/sq.m significantly improved the growth and productivity more than other treatments. Moreover, both fertilizers improved forage quality by increasing crude protein and decreasing crude fiber values. Highest seed yield was obtained at the 15 April sowing date. The yield was moderately lower at the 15 March sowing and much lower at the 15 May sowing. The reduced yield of the 15 March sowing was due to fewer main stems and pods per plant /sq.m. The much decreased yield at the 15 May sowing resulted from a reduction in both seed number per pod and seed yield /plant. Row spacing had non significant effect on number of pods / plant or crude fiber % without significant interactions .The results of the two seasons indicated that the highest plant density (50 plants/sq.m) considerably increased the seed yield g/plant.

Keywords: Hyacinth bean - growth - yield -fertilizer –sowing date - row spacing

INTRODUCTION

The production of forage crop is very important to livestock's production .This is due to huge animal resources in Egypt. Hyacinth bean, *(Dolichos lablab L.)* Fam.Leguminosae , is annual or perennial glabrous climbing plant slightly hairy 1,5- 3 m.long .The flowers are white or purple and seeds white , red ,brown or black to speckled .It is grown during the dry season ,drought-resistant, adapted to high temperatures and sensitive to day length .Plants have high yields of vegetative mass and are used for green manure and soil improvement. Plants show fairly good resistance to certain pests and diseases (Bailey and Bailey 1976 and Rice *et al.*, 1990). The plant is cultivated as fodder, grazed by animals especially in summer season ,as ornamental and medicinal plant. Small leaves and pods are cooked. Seeds are edible after boiling to destroy the toxic glycosides. They are antipyretics, antispasmodic and aphrodisiac. (Watt & Brandwijk, 1962 ; Kotb, 1988 and Roecklein & Leung, 1987) .The effect of nitrogen and phosphorus fertilization on vegetative growth and yields was studied by many authors such as, Mohammed and Abu Sowaar (1996) Patel, (1994) and Atwal and Sidhu, (1964) showed that pod yield was increased by nitrogen application. They recorded that application of mineral N. fertilizer (60kg N/ha) increased yield

of shoot but not dry matter. Phosphorus is essential in the energy transfer processes and is vital to plant growth. It enhances root growth, increases crop ability to extract moisture, hastens plant maturity and is essential to seed formation (Huxley 1980 and MAFF/ADAS 1988). Sowing dates between the end of June and mid July gave maximum yields, earlier sowing resulted in a modest reduction in yield and later sowings caused a shortfall in yield of cluster bean (Jain *et al.*1987).

Shehu, *et al.* (2001) on *Lablab purpureus* , found that late sowing (August) resulted in a considerable reduction in yield and increased crude protein. Effect of row spacing on yield depends on fertilizer type. Tiwana and Tiwana (1993) observed no differences in yield of guar when differences in row space width were small.However, Bhadoria and Chauhan (1994),on cluster bean found higher yields at 45cm than at 30-cm row spacing and that the extent of the difference was dependent on sowing date. Row spacing was found to have no effect on either the gum percentage in the seed or on gum yield of guar (Malik *et,al.* 1981,and Taneja *et,al.*1982). The best total yield and pod characters of pole beans cultivars under plastic house condition occurred with plant density of 4.4 and 6.6 plants/m^2 (Youssef and Hafez, 1996). Hussein & Ismail (1991) reported that a plant density of three plants /hill under plastic conditions increased yield and improved pod character of climbing beans. Jenkins and Hare(1957) found that 1 to 6 plants per 30 cm of row and two plants per hill at 60 cm. apart were best for the semi- bush southern peas.

In some crops, spacing has an indirect effect on weed control, which means low weed competition to the main crop, Moody, (1973).

This study was carried out to investigate the effects of N and P fertilizers, singly and in combination, also to evaluate sowing dates and row spacing on hyacinth bean plant growth and seed yield ,(crude protein and crude fibre).

MATERIALS AND METHODS

Two field experiments were conducted during the two successive growth seasons of 2000 and 2001 in a special farm at EL-Husscin Village, Nobaria, El-Bihira Governorate, Lat., 31°-02˙ ; Long 30°-28˙,Sea level elevation 7.4m.Climatic criteria of this area are presented in Table (1). The soil was sandy with organic matter (0.65%) having pH (1:2.5) ; 8.4 EC (mmohs/cm^2) ; 0.78, total N% 0.22 and available phosphorus 46.5(ppm). The investigated hyacinth bean,(*Dolichos lablab* .L) seeds were obtained from Tropical Research Station, ARC (Agric. Research Center),Ministry of Agriculture, Komombo district, Aswan Governorate. The experimental site was carefully prepared, ploughed and leveled. Ridging up of the leveled land was done and sprinkler irrigation was established. Seeds were scarified with sand paper and soaked in water before planting for (24 hours). The seeds were sown in plots of 4x5m, 30 cm apart. The actual seed rate was 2g/m^2 (2-4seeds/ hole). Immediately prior to sowing, seeds were inoculated by immersion in Vitvax solution. Irrigation was applied after sowing every 7-10 day intervals or as required. Removal of weeds mainly nut grass was done

manually when necessary. Other cultural practices were applied according to the recommendations of Ministry of Agriculture.

First experiment (Fertilization)

Four levels of fertilizer combinations of urea (46%N) and Phosphorus (46% p_2o_5) in a form of granulated triple superphosphate were applied, as follows :

- zero urea+zero phosphorus(0N0P)as a control
- zero urea+ 20g P_2O_5/m^2 (0N2P)
- 10 g N/m^2+zero phosphorus (2N0p)and
- 10 g N/m^2+20g p_2o_5/m^2(2N2P).

Phosphorus fertilizer was applied at time of sowing(mid of April), whereas half amount of urea was applied at time of sowing, the other half was applied 30 days after sowing

The second experiment

A-Sowing dates: were selected to give an early, mid-season and late sowing time. They were on: March 15th, April 15th, and May 15th in both seasons of 2000 and 2001.

B-Row spacing: Three row spacings of 20, 30, and 40 cm. were used. Inter-row spacing was 10 cm to give plant densities of 50 , 38 and 25 plants $/m^2$ respectively.Planting time was a mid of April.

The plants were sampled at 70 days after sowing. At this sampling for each sowing date, (three plants from each experimental plot) were randomly selected and cut off at ground level. Sample plants were labeled placed in plastic bags and stored in a cold room at 5^0C until measurements could be made, then collected together and dried on an electric oven at 105^0 C for 24 hours.

The following measurements were recorded during both seasons: -

-Plant height (cm.),

-Number of branches /plant.

-Leaf area cm^2/leaf was obtained using an electronic planimeter.

Leaf fresh and dry weights (g).

NAR(Net Assimilation Rate):= $\frac{W2-W1 \times \text{Log } L2-\text{Log } L1}{T2-T1 \times L2 - L1}$ $mg/cm^2/day$

Where W2& W1 are dry weights and L2,and L1 are leaf area at sampling times T2 and T1, respectively, assessed every 30 days after the start of experiment till before the beginning of flowering stage.

At harvesting time (three months after sowing)the following data were recorded : -

- Number of pods /plant.
- Seed yield g/plant
- The crude (protein and fiber) percentage in dry seeds were determined by micro kjeldahl method (Jackson,1973) and (AOAC,1990)

Experimental Design : A randomized complete block design was used with three sowing dates and three different row spacings with three replicates each containing three plants. As for fertilization a RCBD four treaments with three replicates was adopted. Data were subjected to proper statistical analysis according to Mead et,al.(1993). Mean comparisons were conducted using LSD values at 0.05 significance level.

Table (1): Agro- meteorological data means for the study area during 2000 and 2001. Station of Nobaria

Characteristics	March	April	May	June	July	August
Air temp. mean Min.C	10.2	12.5	15.2	18.9	20.4	20.9
Air temp. mean Max .C	24.3	28.6	31.8	34.4	34.6	34.9
Relative Humidity %	51	54	50	53	62	63
Precipitation mm/mm	1.1	1.1	0.2	0	0	0
Evapotranspiration mm/day	9.1	10.2	11.8	12.5	10.4	9.3
Sun shine %	33	75	81	86	87	89
Wind speed m/sec at 2 m height	3.81	3.64	3.56	3.28	2.97	2.35

Source: Central Laboratory for Agriculture Climate. ARC, Min., of Agriculture and Land Reclamation.

RESULTS AND DISCUSSION

First experiment : Fertilization

I. Effect of treatments on growth parameters

Nitrogen and phosphorus fertilizer showed a significant effect on hyacinth bean plant during seasons of, 2000 and 2001. Data on yield components are shown in Table (2).

Table (2) : Effect of NP fertilization on the vegetative growth of Dolichos lablab L. during 2000 and 2001 Seasons

Characteristics	Plant height Cm		No. of branches per plant		Leaf area Cm^2		Leaf fresh weight g/plant		Leaf dry weight g/plant		NAR $mg/cm^2/day$	
Treatments	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001
0N*0P** (Control)	78.5	83 2	3 9	4.5	18.3	18.6	0 9	0 8	0 06	0.08	0.08	0.09
0N2P	98 2	103 4	5.7	8 6	26.6	25 4	2 7	2.6	0 08	0.09	0 12	0 14
2N0P	129 2	134 8	7.6	9 9	29.9	30 2	2.9	2.9	0.09	0.12	0 23	0.25
2N2P	145 6	151.6	10 3	11.4	32 2	33 7	3.1	3.2	0.12	0.13	0 32	0 33
Mean	112.5	118.2	6.8	8.1	26.7	26.9	2.4	2.3	0 09	0.10	0.19	0 20
LSD at 5 %	8.5	8.7	0.60	0.61	N S	N.S	0.14	0 15	0.02	0.02	0.05	0 06

N*= nitrogen.
P**=phosphorus.

The hyacinth bean provide some of their own nitrogen requirement through atmospheric nitrogen fixation. They may require a small dose of nitrogen as a starter for this process. (Atwal and Sidhu ,1964). The amount of nitrogen added during this experiment was equivalent to $10gN/m^2$, therefore, it may acted as a starter and had a positive effect on green leaves, plant height, forage dry weight and net assimilation rate (NAR). Treatments of

10gN + 20g P_2O_5/m^2 (2N2P) and 10g N/m^2 + zero P_2O_5, revealed high yield results of plant height and the number of branches/plant compared with control during both seasons. The highest net assimilation rate (NAR) was obtained with combination of 10gN and 20 g P_2O_5/sq.m (0.32 and 0.33 mg/cm^2/day). Significant effect of N and P was observed on growth and yield components, viz., plant height (145.6 and 151.6cm) than control (78.5 and 83.2cm) in the first and second seasons, respectively and number of branches/plant (10.3 and 11.4). Atwal & Sidhu, (1964) and Rice *et al.*, (1990) reported that the application of nitrogen to hyacinth beans in small dozes improved production, growth and nitrogen fixation.

N and P fertilization increased significantly the vegetative yield (NAR) of the hyacinth bean. The increase in the vegetative yield due to NP applications was linear up to its highest level, i.e. 10 gN + 20g P_2O_5/m^2. The results were in accordance with the finding of Huxley, (1980)on cowpea and Patel (1994) on *Dolichos lablab*,L.

II. The effect of N and P treatments on yield and nutritive value:

The results presented in Table (3) indicated that nitrogen and phosphorus fertilizers significantly increased number of pods/plant, seed yield /plant and crude protein %, while their effects on crude fiber % were not significant. The highest value of seed yield per sq.m was obtained as a result of 10gN + 20g P_2O_5 m^2. In this connection, MAFF/ADAS (1988) reported that the formation of fruits and seeds is especially depressed in plants suffering from P deficiency.

Data in Table (3) showed that number of pods/plant and seed yield g/plant were significantly increased by adding N_2 up to $10g/m^2$. On the other hand, phosphorus fertilization had no pronounced effect on seed yield /plant. The above mentioned results indicated the need of plants to the applied of N and P. A reduction in synthesis of RNA as a result of inadequate P supply has an impact on protein synthesis. An accumulation of low molecular weight N compounds was often observed in P deficient tissues (Mohammed and AbuSowaar, 1996). P application did not show any significant influence on crude fibre %. The plants suffering from N and P deficiency, as in control, are stunted with a limited root system and thin stems and frequently the development and the opening of buds is unsatisfactory.

The application of nitrogen and phosphorus fertilizers to leguminous forages significantly improved the growth and productivity during both seasons. Moreover, nitrogen and phosphorus fertilizers improved forage quality as indicated by the high crude protein and low crude fiber values. Hyacinth bean productivity exceeded those of other forages during both seasons. This encouraging result should be the promising for the future of this multiple use crop to be raised under Egypt conditions, with acceptable levels of forage yield during the dry summer months. These results were agreed with those of Duke, (1981) on legumes.

Table (3) : Effect of NP fertilization on number of pods, seed yields, and crude (protein & fibre of *Dolichos lablab* L.plant during 2000 and 2001 seasons.

Characteristics / Treatments	No. of pods per plant		Seed yield g/plant		Crude protein %		Crude fibre %	
	2000	2001	2000	2001	2000	2001	2000	2001
0N*0P** (Control)	17.3	19.9	1.02	1.14	12.4	12.6	3.1	3.4
0N2P	19.5	21.7	1.19	1.23	14.6	15.3	2.6	2.8
2N0P	25.4	28.5	1.50	1.68	19.4	20.2	2.3	2.6
2N2P	32.2	35.6	1.92	2.10	22.7	23.2	1.9	1.9
Mean	23.6	26.4	1.40	1.53	17.2	17.8	2.4	2.6
LSD at 5%	2.16	2.19	0.18	0.19	3.5	3.6	N.S	N.S

N*= nitrogen.
P**=phosphorus.

III. The second experiment:

The effect of sowing dates and row spacings on growth parameters. It is clear from the data in Table (4) that there were significant differences at 5% level in the yield of hyacinth bean seeds per plant of the various sowing dates. The yields of seeds were the highest at mid of April than the other two sowing dates. They were 1.50, 1.40 and 1.10 gm in April, May and March, respectively during season of 2000. Sowing date had a significant effect on leaf dry weight and NAR, since, they were significantly greater in the 15 April sowing than in the later sowing 15 May. The crop sown in mid-May gave the shortest plants and the least number of branches/plant. These data could be explained on the basis of the raise of air temperature (May and June) would suppress cell enlargement and cell division of the negative buds. Since the branch number per plant could be considered as an outward expression for the merestimatic efficiency of the plant. Application of sowing date at 15 April and row spacing 30 cm significantly increased pods and seed weight/plant in 2000 and plant height and pods/plant in 2001 (Table 5). However the differences between pods/plant amongst row spacings were not obvious.

Table (4) : Effect of NP fertilization on the vegetative growth of Dolichos lablab L. during 2000 and 2001 Seasons

Characteristics / Treatments	Plant height cm		No. of Branches per plant		Leaf area cm^2		Leaf fresh weight g/plant		Leaf dry weight g/plant		NAR $mg/cm^2/day$	
	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001
Sowing dates												
March15th	125.1	129.2	4.4	4.8	22.3	23.4	2.4	2.5	0.09	0.09	0.23	0.23
April15th	141.4	147.3	5.6	5.9	28.5	29.7	2.7	2.7	0.11	0.12	0.29	0.30
May15th	107.3	109.7	3.8	4.3	19.7	20.5	1.9	1.9	0.07	0.07	0.18	0.18
Mean	124.6	128.7	4.8	5.0	23.5	24.5	2.3	2.3	0.09	0.09	0.23	0.23
Row Spacing												
20 cm	91.7	89.6	4.3	4.7	25.2	26.6	2.4	2.8	0.12	0.18	0.27	0.29
30 cm	132.8	138.2	6.5	7.2	24.3	26.5	2.8	3.2	0.14	0.16	0.28	0.32
40 cm	147.3	149.4	6.3	6.7	30.4	31.8	2.2	2.7	0.11	0.12	0.32	0.34
Mean	123.9	128.0	6.3	6.8	26.6	28.3	2.4	2.9	0.12	0.15	0.29	0.31
G.Mean	124.2	128.4	5.4	5.9	25.0	26.4	2.3	2.6	0.10	0.12	0.26	0.27
LSD at 5%												
Dates A	6.1	6.2	1.9	1.9	1.7	1.8	0.3	0.4	0.01	0.02	0.02	0.02
Spackign B	6.1	6.2	1.9	1.9	1.7	1.8	0.3	0.4	0.01	0.02	0.02	0.02

Table (5) : Effect of sowing dates and row spacing on number of pods, seed yield, crude (Protein & Fibre) of *Dolichos lablab L* plant during 2000 and 2001 seasons.

Characteristics / Treatments	No. of pods/plant		Seed yield per plant (g)		Crude protein % dry seeds		Crude fibre % dry seeds	
	2000	2001	2000	2001	2000	2001	2000	2001
Sowing dates								
March 15th	18 4	18.9	1.10	1.30	19 6	19.8	3 3	3 8
April 15th	20.5	21.2	1.50	1 8	22 8	23.2	6.1	6 4
May 15th	19.2	19.8	1.40	1.6	17 9	18.2	4.6	4 8
Mean	19 3	19 9	1 3	1 5	20 1	20 4	4 6	4 9
Row spacing								
20 cm	19.8	19.9	1.1	1.2	17 7	18.5	2.4	2 9
30 cm	22.4	22.7	1.3	1.4	22 3	22.8	2.8	2 5
40 cm	27.4	27.9	1.5	1 6	16 6	19.2	4.3	4.9
Mean	23.2	23.5	1.3	1 4	19 5	20.2	3.1	3 4
G Mean	21.2	21.7	1.3	1.4	19.8	20.3	3.8	4.2
LSD at 5 %								
Dates A	0.06	0.07	0.1	0.12	2.21	2.22	0.2	0 2
Spacing B	0.06	0.07	0.1	0.12	2.21	2.23	0 2	0 2

It may be concluded that planting hyacinth bean in mid April appears to be the optimum time of planting. Sowing on 15 April was the best time for obtaining the maximum vegetative growth (NAR) and seed yield. The crude protein % yields were higher when hyacinth bean was planted on 15 April (22.8 and 23.2%) compared to that planted early on 15 March (19.6 and 19.8%)and late on 15 May (17.9 and 18.2%).Jain, *et al.*, (1987) on cluster bean reported that late sowing resulted in a considerable reduction in yield, increased crude protein and reduced modified crude fibre concentrations.

Similar results were obtained by Bhadoria and Chauhan, (1994)on cluster bean; Jenkins and Hare (1957)on Southern peas ;Moody, (1973)on cowpeas and Yadav and Uttam(1994)on Brassica juncea

Concerning row spacing, high plant density (200,000 plants/fe) recorded the highest seed yield, which was on a par with medium plant density (152,000 plant/fed).

Row spacing had no significant effect on total leaf area/plant. In wider row spacing (40 cm/m^2) branches/plant, plant height, and NAP were significantly higher than other treatments of closer population.This coincided with the findings of Taneja *et a/.* (1982) and Tiwana and Tiwana (1993). The mean increase in plant population density from 25 to 38 plants/sq.m decreased NAA yield from 0.34 to 0.32 mg/cm^2/ day but a further increase in population to 50 plants/m^2 did not increase yield(-0.2g mg/cm^2/ day). Row spacing of 40 cm gave the greatest plant height (149.4 cm) more than other spacings (20cm and 30cm gave 96.6 and 138.2, respectively) during 2001 season.

Row spacing of 20 cm and 40 cm resulted significantly higher values of these attributes than 20cm. An increase in number of plants reduced the number of branches/plant at all stages of crop growth till harvest during the two seasons. In wider row spacing 40cm plant height, number of branches/plant and NAR were significantly higher than other treatments of closer population. These results agreed with those reported by Tiwana and

Tiwana (1993) on guar, Hussein and Ismail (1991) on climbining beans and Youssef and Hafez (1996) on pole beans.

Interactions:

Data in tables (4 and 5) showed that the greatest plant height, seed yield and crude protein % was due to sowing hyacinth bean, on 15 April in rows spaced 40 cm apart in both seasons. This could be assigned to the maximum seed productivity resulted from sowing on this date at 40 cm row spacing.

Therefore, to improve the productivity of hyacinth bean, application of N and P fertilizer is essential. On the basis of the two years data, it may be concluded that cultivation of hyacinth bean and supplying them with 10gN and 20g P_2O_5/sq.m in mid April at 40 cm row spacing under Nubaria conditions results in satisfactory yield.

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تأثير الأسمدة النتروجينية والفوسفاتية ومواعيد ومسافات الزراعة علـــى النمـــو والإنتاجية لنبات الكشرنجيج

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أجريت هذه الدراسة لتقييم أربعة تركيزات من الأسمدة وهى اليوريا (٤٦%) نيتروجين، سوبر فوسفات الثلاثي (٤٦%) فوسفور، وأيضا ثلاثة مواعيد للزراعة هى : منتصف كـــل مـــن شهور (مارس – ابريل – مايو) وكذلك ثلاثة مسافات زراعة هى (٢٠ – ٣٠ – ٤٠سم) لتكـــون كثافة نباتية تحتل (٥٠ – ٣٨ – ٢٥) نبات لكل متر مربع على التوالي خـــلال عـــامى (٢٠٠٠-٢٠٠١) على النمو الخضري والإنتاجية والبروتين الخام لنبات الكشرنجيج.

وبعد الدراسة تم استنتاج ما يلي :

- أن تطبيقات استخدام أسمدة اليوريا، السوبر فوسفات بمعدل ١٠جم نتروجين/م^{٢} + ٢٠جم ســوبر فوسفات (فو$_{٢}$أ$_{٥}$)/م^{٢} قد حسنت معنويا من معدلات النمو والإنتاجية عن المعدلات الأخرى، وعـــلاوة على ذلك فإن معدل التسميد بهذه النسبة قد حسن من نوعية العلف لزيادة البروتين الخام وتنـــاقص نسبة الألياف الخام.

-كما لوحظ أيضا أن ارتفاع إنتاجية البذور تم الحصول عليها من النباتات التـــي زرعـــت فـــي منتصف ابريل – وكان الإنتاج أقل نوعا عند زراعة النباتات في شهر مايو، كما وجـــد انخفـــاض ملحوظ عند الزراعة في منتصف مارس وترجع قيمة الانخفاض في منتصف شهر مـــارس إلـــى النقص في عدد القرون وقصر الساق/م^{٢}.

أما التناقص الناتج عن الزراعة في شهر مايو فيرجع إلى قلة عدد البذور في القرن مـــع قلة إنتاج البذرة لكل نبات.

ولم يكن لاختلاف مسافات الزراعة تأثير معنوي واضح على عدد القرون لكل نبـــات أو النسبة المئوية للألياف الخام ولم تظهر أى فروق معنوية عند حساب التفاعل بين مواعيد الزراعـــة ومسافات الزراعة.