J. Appl. Environ. Biol. Sci., 8(7)10-19, 2018
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ISSN: 2090-4274
Journal of Applied Environmental and Biological Sciences
www.textroad.com

Growth and Yield Response of Mungbean under the Influence of Nitrogen and Phosphorus Combination Levels

Sanaullah Jamro[1], Muhammad Ali Ansari[1], Majid Ali Jamro[2], Muhammad Irfan Ahmad[3], Waheed Ahmed Siddiqui[4], Shahid Ahmad Junejo[5], Soualihou Soualiou[3], Sikandar Ali Jamro[3]

[1]Department of Agronomy, Sindh Agricultural University, Tando Jam Pakistan.
[2]Department of Plant Breading and Genetics, Shaheed Zulfiquar Ali Bhutto, Agriculture Collage Dokri
[3]School of Agronomy, Anhui Agriculture University Hefei - 230036, Anhui Province, P.R. China
[4]Agriculture engineering Department, Anhui Agricultural University, Hefei -230036, Anhui Province, P.R. China
[5]School of Tea and Food Science Technology, Anhui Agricultural University, Hefei -230036, Anhui Province, P.R. China

Received: August 28, 2017
Accepted: April 11, 2018

ABSTRACT

The results of the experiment showed that various combination of Nitrogen and Phosphorus (NP) levels significantly affected crop parameters. The maximum crop stand m^{-2} (128.7), plant height cm (59.54), number of branches $plant^{-1}$ (12.74), number of pods $plant^{-1}$ (33.32), number of seeds $plant^{-1}$ (376.2) seed weight $plant^{-1}$ (17.61 g) seed index (32.05 g) and seed yield (2290.0 kg ha^{-1}) were found with the application of NP combination level of 50-75 kg ha^{-1}. Whereas, for varieties, V1 i.e. AEM-96 surpass in all parameters as compared to V_2 i.e. NM-94, which gave maximum (120.11) crop stand m-^{2}, maximum (52.55 cm) plant height, 10.67 plant m^{-2}, maximum (24.03) branches $plant^{-1}$, maximum (15.07) pods $plant^{-1}$, maximum (30.01 g) seed weight $plant^{-1}$ and maximum (2439.2 kg ha^{-1}) seed yield. Among the interactions the highest seed yield was recorded in variety AEM-96 with NP combination level of 50-75 kg ha^{-1} followed by the interaction of variety AEM-96 with NP combination of 50-50 kg ha^{-1}, whereas lowest seed yield kg ha^{-1} was recorded variety NM-94 with NP combination 25.00 kg ha^{-1}The variety AEM-96 under NP combination level 50-75 kg ha^{-1} perform better and gave highest yield 2439.2 kg ha^{-1}.
KEYWORDS: Fertilizer; Yield; agronomic parameters; Mungbean

INTRODUCTION

Mungbean or green gram *(Vignaradiata*. L.*)* is commonly known as mung. It belongs to family leguminoceae. It is an important pulse crop having high nutritional value and low cost protein, containing fair amount of protein (24.21 %), vitamin A (80 units), carbohydrates 69.30 % and high caloric value. It restores the fertility of soil by fixing atmospheric nitrogen through root nodules. In Pakistan, it is grown on as area of about 239.2 thousand hectares with the total annual production of 115.4 thousand tones. In Sindh province the mungbean is cultivated on an area of 11.1 thousand hectares with the annual production of 5.5 thousand tones (Pakistan Statistical Year Book, 2003).[1]
The production of mung is still very low as compared to other developed countries due to various constraints. Among them, appropriate fertilizer application plays an important role for the growth and yield of the mungbean crop. According to Prasad *et al*. (1998) [2] that potassium increased the total biomass and plant protein in mungbean. Malik *et al*. (2000) [3] reported that maximum seed index, grain yield and protein were obtained satisfactory from the plots where inoculated seed was grown with phosphorous applied at the rate of 50 kg ha^{-1}. Thus, increase in grain yield was attributed to increase the number of pods per plant, number of grains per pod and heavier grain weight. Abd-El-Lateef *et al*. (1998a) [4] noted that the application of urea with Zn increased the number of branches per plant and protein content in seeds while, the greatest numbers of leaves per plant were produced from the combined application of urea with Mn, Zn and Cu. Further, Bamel*et al*. (2002) [5] reported that combination of N, P, K and Zn fertilizer at the recommended rate resulted in better plant growth as well as reduced nematode damage individually, and application of di-ammonium phosphate at higher rate resulted in the better plant growth. Being a leguminous crop, mungbean does not need a high dose of nitrogenous fertilizer however 20 kg N ha^{-1} as a starter dose was found for good crop growth and accelerated nodulation. Rajender*et al*. (2003) [6] also observed that grain yield at mungbean increased with nitrogen at the rate of 20 kg ha-^{1} over control and crop

Corresponding Author: Sikandar Ali Jamro, School of Agronomy Anhui Agriculture University Hefei - 230036, Anhui Province, P. R. China

exhibited better cost benefit ratio however Patel *et al.* (2003) [7] with careful investigations found that 10 kg N ha-^{1} was enough better mungbean crop production.

Field crops require 16 essential nutrients to grow normally. Carbon, Hydrogen and oxygen are derived from the air comprise greater than 90 per cent of the fresh plant tissue. Macronutrients, needed in large amounts, derived from the soil are nitrogen, phosphorus, potassium, sulphur, calcium, and magnesium. Legumes are the exception because they fix N from the air. With a few exceptions, Ca and Mg are not limiting because of the nature of the soils. The soil supply of N, P, K, and S is often supplemented by fertilizers and manure. The remaining essential nutrients, derived from the soil, are referred to as micronutrients, because they are needed in small amounts (Sharma *et al.,* 2003). [8]

For plant growth and development, the role of essential nutrients like N, P and K is of prime importance. Nitrogen has important role in the physiological process of the plant and its appropriate rate at the time of sowing leads to rapid leaf area development, prolongs leaves life, improves leaf area duration (LAD), after flowering causing increase in overall assimilation rate, thus contributing to increased seed yield. Phosphorus helps in energy transfer reactions and is important for the growth of roots and branches of the plants, whereas its deficiency restricts both top and root growth. With severe deficiency, the root system is poorly developed and stems are thin and erect with few branches and small, narrow leaves (Tahir *et al*., 2003)[9]. The Potassium has key role in increasing the plant vigor, straw length and helps in speedy healing of wounds caused by insects or hail and wind. Deficiency of potassium also causes in yield reduction due to stunt growth of plants and seeds of small size (Balasubramaniyan and Palaniappan, 2001) [10]. The growers mostly apply nitrogenous, phosphatic and to some extent potassic fertilizers. However, the recent studies revealed that the application of P is an essential element for maintaining the soil fertility. Deficiency of P is attributed to removal by high yielding crop varieties, use of high doses and pure forms of NPK nutrient fertilizers and intensive system of cultivation (Anonymous, 2003).[1]

Generally in rainfed areas, no fertilizers and manures are applied; in some places farmers may apply a small amount of F.Y.M. (e.g. 8-15 t ha^{-1}) 3-4 weeks before sowing. In irrigated areas, a small amount of mineral fertilizer (10-15 kg ha^{-1} N, 20-30 kg ha^{-1} P_2O_5) is either placed in the seed furrow or broadcast and mixed in the soil. Under improved cultivation practices: irrigated, basal application of 18-20 kg ha^{-1} N, 40-50 kg ha^{-1} P_2O_5, plus K, Zn, S if required; un-irrigated, basal application of 10-15 kg ha^{-1} N and 20-30 kg ha^{-1} P_2O_5, followed by a foliar spray of 2 % urea at pod development. Di-ammonium phosphate, urea and single super phosphate are commonly used (Zeven, 1998) [11].

Singh *et al.* (2001) [12]cultivated *Vignaradiata* , cv. K-851, in 30, 60 or 90 kg P_2O_5 and 5, 10 or 15 ppm Zn, compared with untreated controls. P and Zn application increased the seed protein, N and P contains higher P_2O_5 increased seed yield considerably. Thakur and Giri (2001)[13] applied 0, 25, 50 or 75 kg P_2O_5 ha^{-1} as Single Super Phosphate or Di-ammonium Phosphate is mungbean, *Vignaradiata*(L). seed and straw yields were not significantly affected by P source, and seed yield average of 0.91 , 1.00, 1.24 and 1.13 t ha^{-1} at the 4 P rates, respectively. P uptake was also highest with 50 kg P_2O_5.

Keeping in view the importance of mungbean as pulse crop and its management in relation to chemical fertilizers, the present experiment was conducted to examine the growth and yield response of mungbeanunder the influence of NP combination levels under agro-ecological conditions of Tandojam.To evaluate the impact of NP levels on growth, yield and yield components of mungbean,To determine the most appropriate NP level for maximizing mungbean yield.

MATERIALS AND METHODS

An was carried out to evaluate the growth and yield response of mungbean under the influence of NP combination levels during the year 2013 at the Experimental Area of Oilseeds Section, Agriculture Research Institute, Tandojam. The detail of the experiment was as under:

Experimental design: Randomized Complete Block Design (RCBD)

Replications: 03

Plot size:3 x 3 m = (9 m^{2})

Treatment Two factor (A and B)

Factor –A = Varieties = 02

V_1= AEM-96 V_2= NM-94

Factor-B NP Fertilizer Combinations = 07

F0= (Control) 0-0 NP, F1= 25-0 NP kg ha^{-1}, F2=25-50NP kg ha^{-1}

F3= 25-75 NP kg ha^{-1} , F4= 50-0 NP kg ha^{-1}, F5=50-50 NP kg ha^{-1}

F6= 50-75 NP kg ha^{-1}

Treatment combinat ions

$T_1 = V_1 F_1$	$T2 = V_1 F_2$	$T3 = V_1 F_3$	$T4 = V_1 F_4$
$T5 = V_1 F_5$	$T6 = V_1 F_6$	$T7 = V_2 F_1$	$T8 = V_2 F_2$
$T9 = V_2 F_3$	$T10 = V_2 F_4$	$T11 = V_2 F_5$	$T12 = V_2 F_6$

Land preparation

A suitable piece of land which was lying fallow was ploughed up by cross-wise disc plough, after soaking dose, when the land came in condition the seedbed was prepared by using cultivator (cross-wise) and rotavator. Thereafter, clods were crushed completely by clod crusher followed by planking.

The sowing was done with the help of single coulter hand drill in lines. The treatments were managed in such a way to discriminate the plots or treatments and replications easily the channels and bunds were prepared to facilitate the irrigation process and further monitoring of the crop against any pest problem. The cultivated mungbean two varieties AEM-96 and NM-94 were used in this experiment. The experiment comprised of the following treatments. Phosphorus fertilizer was applied in the form of Single Super Phosphate. As per schedule of treatments, all the Phosphorus in the form of SSP (18 %P_2O_5) was applied at the time of sowing. A uniform dose of nitrogen was also applied to keep the experimental soil adequate in this essential nutrient. Nitrogen was applied in the form of Urea (46%) in three splits. The first dose of nitrogen (1/3 N) was applied at the time of sowing, the second (1/3 N) at the first irrigation and the final (1/3 N) at the time of third irrigation. Irrigations were applied as per the schedule. Potassium fertilizer was not applied, as soil was adequate in K. The row spacing maintained at 75 cm apart and distance between plants was 30 cm. The recommended cultural practices were performed in all the subplots. Irrigations were applied according to the requirements of the crop depending upon the soil moisture conditions. In all two irrigation were applied after 28-days and 50-days after sowing.

Observations recorded

Five plants in each treatment were selected at random for all the observations, these plants were tagged and numbered separately. The observations were recorded on the following parameters.

1. Crop stands m^{-2}
2. Plant height (cm)
3. Branches $plant^{-1}$
4. Pods $plant^{-1}$
5. Seeds $plant^{-1}$
6. Seed weight $plant^{-1}$ (g)
7. Seed index (1000 seed weight, g)
8. Seed yield (kg ha^{-1})

RESULTS

The treatments including on 07 NP fertilizer combination viz. F0=0-0 (Control), F1=25-00, F2=25-50, F3=25-75, F4=50-00, F5=50-50 and F6=50-75 kg ha^{-1}. The observations were recorded on the characters of economic importance such as: Crop stand m^{-2}, plant height (cm), branches $plant^{-1}$, pods $plant^{-1}$, seeds $plant^{-1}$, seed weight $plant^{-1}$, seed index (1000 seed weight, g) and seed yield kg ha^{-1}. The data recorded on the above characters are presented in Table-1 to 8 and their analyses of variances are given as Appendices I to VIII. The findings of results are interpreted in the following paragraphs:

Crop Stand m^{-2}

Crop stand is the major yield component, the results regarding their mean crop stand m^{-2} of mung bean as affected by NP combination levels are presented in Table-1 and its analysis of variance as Appendix-I. The results revealed that there was significant ($P<0.01$) effect on crop stand m^{-2} due to different NP combination levels.

It is apparent from Table-1 that plant stand m^{-2} were significantly affected ($P<0.01$) maximum 128.7 m^{-2} were recorded when mung bean crop was fertilized with highest NP combination level 50-75 kg ha^{-1} followed by NP combination of 50-50 kg ha^{-1}. The mung bean crop when applied lower NP combination i.e. 25-00 kg ha^{-1} which recorded lower crop stand m^{-2}.Further results revealed that variety AEM-96 recorded better crop stand m^{-2} (120.11) than variety NM-94, furthermore, among the interactions of NP combination and varieties. Data displayed the maximum plant stand m^{-2}(130.00) in the interaction of 50-75 x AEM-96 whereas, minimum plant stand m^{-2} 103.33 was recorded in the interaction of 25.00 NP kg ha^{-1} x NM-94.

Table 1. Mean crop stand m^{-2} of mung bean varieties as affected by different NP fertilizer combination levels.

Varieties	NP Fertilizer combination levels kg ha-1						
	F1= 25-00	F2= 25-50	F3= 25-75	F4= 50-00	F5= 50-50	F6= 50-75	Mean
V1= AEM-96	106.67	116.00	122.00	120.00	126.00	130.00	120.11-A
V2= NM-94	103.33	114.00	118.33	117.33	122.33	127.33	117.11-B
Mean	105.0-E	115.0-D	120.2-C	118.7-C	124.2-B	128.7-A	-

S.E. for Treatment Mean					
	Varieties	Fertilizer	V x F	S.E. / Plot	C.V %
	0.2750	0.4763	0.6736	1.1666	0.98 %
Cd-1	0.7800	1.3970	-	-	-
Cd-2	1.0700	1.8999	-	-	-

Plant height (cm)

Plant height is the major growth character which is reflected by the soil fertility under which crop grown. The results regarding the plant height of mungbean as affected by different phosphorus levels are recorded in Table-2 and the analysis of variance as Appendix-II. The analysis of variance suggested that there was significant ($P<0.01$) effect on the plant height of mungbean due to different NP combination levels.

It is apparent from the data in Table-2 that plant height was significantly ($P<0.01$) maximum (59.54 cm) when the mungbean crop was fertilized with highest NP combination of 50-75 kg ha^{-1}, closely followed by NP combination of 50-50 kg ha^{-1} with average plant height of 56.47 cm. The mung bean crop when fertilized with relatively lower NP combination of 25-50 kg ha^{-1}, the average plant height was considerably decreased to 47.70 cm, respectively. The mungbean crop under control plots, where phosphorus was not applied resulted in minimum plant height of 37.58 cm. It was noted that each increased phosphorus level up to 75 kg ha^{-1} substantially improved the plant height. Further results demonstrated that taller plants 52.55 cm were noted in variety AEM-96 than variety NM-94. Furthermore, results revealed that taller plants 61.22 cm were displayed by the interaction of NP combination of 50-75 kg ha^{-1} and variety AEM-96 and smaller plants 35.90 cm were recorded among the interaction of NP combination and varieties i.e. 25.00 NP kg ha^{-1} and variety NM-94.

Table 2. Mean plant height (cm) of mung bean varieties as affected by different NP fertilizer combination levels.

Varieties	NP Fertilizer combination levels kg ha^{-1}						
	F1= 25-00	F2= 25-50	F3= 25-75	F4= 50-00	F5= 50-50	F6= 50-75	Mean
V1= AEM-96	39.27	48.86	55.50	52.66	57.82	61.22	52.55-A
V2= NM-94	35.90	46.53	53.39	51.93	55.12	57.86	50.12-B
Mean	37.58-F	47.70-E	54.45-C	52.29-D	56.47-B	59.54-A	-

S.E. for Treatment Mean					
	Varieties	Fertilizer	V x F	S.E. / Plot	C.V %
	0.1778	0.3079	0.4355	0.7543	1.47 %
Cd-1	0.5100	0.9032	-	-	-
Cd-2	0.7000	1.2280	-	-	-

Number of branches $plant^{-1}$

Number of branches is one of the most important growth character as well as yield contributing trait which resulted that more pods plant^{-1}. The data pertaining to the number of branches plant^{-1}of mung bean as affected by different NP combination are presented in Table-3 and the analysis of variance is shown as Appendix-III. The results of the analysis of variance suggested that the number of branches plant^{-1} significantly (P<0.01) affected due to different NP combination levels.

The mung bean crop fertilized with highest NP combination produced significantly (P<0.01) highest number of branches (12.74) plant^{-1}, closely followed by NP combination of 50-50 kg ha^{-1} with 12.04 branches plant^{-1} and variety AEM-96 displayed maximum branches 10.67 plant^{-1} than variety NM-94. Further among the interaction of NP combination and varieties, the maximum branches (13.27) plant^{-1} were recorded in the interaction of 50-75 NP kg ha^{-1} and AEM-96 minimum number of branches (5.21) plant^{-1} were noted in the interaction of 25.00 NP kg ha^{-1} and variety NM-94. However, in plots where the mung bean crop was left without NP had lowest number of branches (6.15) plant^{-1}.

Table 3. Mean number of branches plant^{-1} of mung bean varieties as affected by different NP fertilizer combination levels.

Varieties	NP Fertilizer combination levels kg ha^{-1}						
	F1= 25-00	F2= 25-50	F3= 25-75	F4= 50-00	F5= 50-50	F6= 50-75	Mean
V1= AEM-96	7.09	9.21	11.45	10.51	12.48	13.27	10.67-A
V2= NM-94	5.21	8.36	10.70	9.35	11.60	12.22	9.57-B
Mean	6.15-E	8.78-D	11.08-B	9.93-C	12.04-AB	12.74-A	-

S.E. for Treatment Mean					
	Varieties	Fertilizer	V x F	S.E. / Plot	C.V %
	0.1497	0.2593	0.3667	0.6348	6.28 %
Cd-1	0.4300	0.7601	-	-	-
Cd-2	0.5900	1.0330	-	-	-

Number of pods plant^{-1}

Number of pods plant^{-1} is mainly associated with the number of branches plant^{-1} and generally it is assumed that more the number of branches plant^{-1}, greater will be the number of pods. The results regarding the number of pods plant^{-1} of mungbean as affected by different fertilizer NP combination are given in Table-4 and the analysis of variance as Appendix-IV. The analysis of variance illustrated that the number of pods plant^{-1} was affected significantly (P<0.01) due to different NP combination levels.

Variety AEM-96 recorded maximum number of pods plant^{-1} than variety NM-94. Further the results among the interactions of NP combination and varieties, the highest number of pods plant^{-1} 34.63 were obtained in the interaction of NP combination of 50-75 kg ha^{-1} and variety AEM-96 and minimum number of pods plant^{-1} 14.40 were recorded in the interaction of 25.00 kg ha^{-1} and variety NM-94. It is obvious from Table-4, that the mung bean crop fertilized with highest NP combination of 50-75 kg P ha^{-1}, produced significantly (P<0.01) maximum number of pods plant^{-1}, closely followed by NP combination of 50-50 kg ha^{-1} where the crop bearing average of 33.32 pods plant^{-1}, whereas, the minimum number of pods plant^{-1} (15.80) was recorded in mungbean plants that received zero NP fertilizers (control). It was noted that P application had positive effect on the number of pods, and increase in P levels, significantly improved the number of pods.

Table 4. Mean number of pods plant^{-1} of mung bean varieties as affected by different NP fertilizer combination levels.

Varieties	NP Fertilizer combination levels kg ha^{-1}						
	F1= 25-00	F2= 25-50	F3= 25-75	F4= 50-00	F5= 50-50	F6= 50-75	Mean
V1= AEM-96	17.19	19.09	23.02	21.30	28.92	34.63	24.03-A
V2= NM-94	14.40	16.61	20.37	18.68	27.66	32.00	21.62-B
Mean	15.80-F	17.85-E	21.69-C	19.99-D	28.29-B	33.32-A	-

S.E. for Treatment Mean					
	Varieties	Fertilizer	V x F	S.E. / Plot	C.V %
	0.1832	03173	0.4487	0.7772	3.41 %
Cd-1	**0.5300**	0.9306	-	-	-
Cd-2	**0.7300**	1.2650	-	-	-

Number of seeds plant^{-1}

Number of seeds plant^{-1} is an important character that had direct effect on the seed yield plant^{-1} and per unit area. Generally, it is assumed that more the number of pods, greater will be the number of seeds plant^{-1}. The results regarding the number of seeds plant^{-1} of mung bean as affected by different NP combination levels are given in Table-5, its analysis of variance as Appendix-V. The analysis of variance suggested that the number of seeds plant^{-1} was affected significantly (P<0.01) due to different fertilizer NP combination levels.

It can be seen from Table-5 that highest NP combination level revealed in significantly (P<0.01) highest (376.2) number of seeds plant^{-1}, closely followed by NP combination level of 50-50 NP kg ha^{-1} where the mung bean plant bearing an average of 362.1 seeds plant^{-1}, however, the lowest (184.4) number of seeds plant^{-1} was counted in mung bean plants which received no phosphorus fertilizers (control).

The results further indicated that NP application positively affected the number of seeds, and each increment in NP levels, significantly increased the number of seeds. Further results revealed that maximum number of seeds plant^{-1} 301.42 was recorded by variety AEM-96 than variety NM-94, among the interaction of NP combination and varieties, the highest number of seeds plant-1 (377.4) were recorded by the interactions of 50-75 NP kg ha^{-1} and variety AEM-96 whereas, minimum seeds plant-1 182.7 were noted in the interaction of 25.00 NP kg ha^{-1} and variety NM-94.

Table 5. Mean number of seeds plant^{-1} of mung bean varieties as affected by different NP fertilizer combination levels.

Varieties	NP Fertilizer combination levels kg ha^{-1}						
	F1= 25-00	F2= 25-50	F3= 25-75	F4= 50-00	F5= 50-50	F6= 50-75	Mean
V1= AEM-96	186.2	239.9	327.6	312.3	365.0	377.4	301.42-A
V2= NM-94	182.7	234.2	323.4	306.3	359.2	374.9	296.80-B
Mean	184.4-F	237.0-E	325.5-C	309.3-D	362.1-B	376.2-A	-

S.E. for Treatment Mean					
	Varieties	Fertilizer	V x F	S.E. / Plot	C.V %
	0.2022	0.3502	0.4953	0.8579	0.29 %
Cd-1	**0.5919**	1.0270	1.453	-	-
Cd-2	**0.8064**	1.3960	1.974	-	-

Weight of seed plant-^{1} (g)

The results regarding the weight of seeds plant^{-1} of mungbean as affected by different NP s combination levels are shown in Table-6 and the analysis of variance as Appendix-VI. The results of the analysis of variance described that the weight of seeds plant^{-1} was influenced significantly (P<0.01) due to different NP combination levels.

The results shown in Table-6, indicated that the highest (17.61 g) weight of seeds plant^{-1} was obtained from the mungbean crop which fertilized with highest NP combination, closely followed by 16.39 g average weight of seeds plant^{-1} recorded from the crop receiving 50-50 NP combination kg ha^{-1}. However, the lowest (10.82g) weight of seeds plant^{-1} was noted in mung bean plants which were left unfertilized with P (control). The results further showed that there was a linear effect of increasing P levels on weight of seeds plant^{-1} and there was consecutive improvement in weight of seeds.

Similarly, like number of seeds plant^{-1} variety AEM-96 displayed maximum seeds weight plant^{-1} (15.07 g) than variety NM-94. Among the interactions of NP combination and varieties the highest seeds weight plant^{-}

^{1}(18.72g) were recorded in the interaction of 50-75 NP kg ha^{-1} and variety AEM-96 whereas lowest seeds weight plant^{-1} (10.35 g) were recorded in the interaction of 25.00 NP kg ha^{-1} and variety NM-94.

Table 6. Mean seeds weight plant^{-1} (g) of mung bean varieties as affected by different NP fertilizer combination levels.

Varieties	NP Fertilizer combination levels kg ha^{-1}						
	F1= 25-00	F2= 25-50	F3= 25-75	F4= 50-00	F5= 50-50	F6= 50-75	Mean
V1= AEM-96	11.29	13.23	15.33	14.46	17.52	18.72	15.07-A
V2= NM-94	10.35	12.21	14.46	12.74	15.27	16.50	13.59-B
Mean	10.82-E	12.76-D	14.90-C	13.50-D	16.39-B	17.61-A	-

S.E. for Treatment Mean					
	Varieties	Fertilizer	V x F	S.E. / Plot	C.V %
	0.1141	0.1976	0.2794	0.4837	3.38 %
Cd-1	0.3340	0.5492	-	-	-
Cd-2	0.4550	0.7872	-	-	-

Seed index (1000 seeds weight, g)

Seed index value is generally considered as quantity and quality character in grain seed producing crops and particularly considered. The data pertaining to seed index of mungbean as affected by different NP combination are recorded in Table-7 and the analysis of variance as Appendix-VII. The analysis of variance illustrated that the seed index was influenced significantly (P<0.01) under the effect of different NP combination levels.

It is apparent from the data in Tabsle-7 that seed index value was significantly (P<0.01) higher (32.05 g) when the crop received highest NP combination level of 50-75 kg ha^{-1}, closely followed by NP combination level of 50-50 kg ha^{-1} resulting seed index value of 31.07g. The seed index value under control plots was minimum (27.03 g), where zero NP combination was applied to mung bean crop. It was noted that each increased phosphorus level upto 75 kg ha^{-1} substantially improved the seed index value. The situation suggested that 50-75 NP combination kg P ha^{-1} was an optimum level for producing economical mung bean production.

Further data indicated that highest seed index 30.01 g was displayed by variety AEM-96 than variety NM-94. Among the interactions the maximum seed index 32.47 g was displayed by the interaction of 50-75 NP kg ha^{-1} and variety AEM-96 were as minimum seed index 26.46 was recorded in the interaction of 25.00 NP kg ha-1 and variety NM-94.

Table 7. Mean seed index (1000 seeds weight, g) of mung bean varieties as affected by different NP fertilizer combination levels.

Varieties	NP Fertilizer combination levels kg ha^{-1}						
	F1= 25-00	F2= 25-50	F3= 25-75	F4= 50-00	F5= 50-50	F6= 50-75	Mean
V1= AEM-96	27.61	28.52	30.52	29.40	31.56	32.47	30.01-A
V2= NM-94	26.46	27.41	29.46	28.54	30.58	31.64	29.01-B
Mean	27.03-F	27.97-E	29.99-C	28.97-D	31.07-B	32.05-A	-

S.E. for Treatment Mean					
	Varieties	Fertilizer	V x F	S.E. / Plot	C.V %
	0.1331	0.2305	0.3260	0.5648	1.91 %
Cd-1	0.3896	0.6763	-	-	-
Cd-2	0.5308	0.9192	-	-	-

Seed yield (kg ha^{-1})

The seed yield ha^{-1} is a character of ultimate important and most of the studies focus to reach its highest NP combination under certain treatments or crop varieties. The results regarding the seed yield ha^{-1} of mungbean as affected by different NP combination levels are recorded in Table-8 and the analysis of variance as Appendix-VIII. The analysis of variance illustrated that the seed yield ha^{-1} was significantly ($P<0.01$) affected due to different NP combination levels.

It can be seen from the results presented in Table-8 that the highest seed yield (2290.0 kg ha^{-1}) was obtained from the mungbean crop fertilized with highest NP combination level of 50-75 kg P ha^{-1}, while it was closely followed by an average seed yield of 2058.0 kg ha^{-1} was recorded from the crop receiving NP combination of 50-50 kg ha^{-1}. However, the minimum seed yield of 1153.0 kg ha^{-1} was recorded from the plots receiving zero phosphorus fertilizer (control). The results further suggested that there was a linear effect of increasing P levels upto 75 kg ha^{-1} on seed yield ha^{-1}. Further the results revealed that maximum seed yield kg ha^{-1} 1832.80 was recorded by the variety AEM-96 than variety NM-94. Among the interactions the results reported that highest seed yield 2439.2 kg ha^{-1} was recorded by the interaction of 50-75 NP kg ha^{-1} and variety AEM-96, but lowest seed yield kg ha^{-1} 1103.8 was noted in the interaction of 25.00 NP kg ha^{-1} and varieties.

Table 8. Mean seed yield (kg ha^{-1}) of mung bean varieties as affected by different NP fertilizer combination levels.

Varieties	Fertilizer NP combination levels kg ha^{-1}						
	F1= 25-00	**F2= 25-50**	**F3= 25-75**	**F4= 50-00**	**F5= 50-50**	**F6= 50-75**	**Mean**
V1= AEM-96	1202.4	1571.0	1858.6	1686.7	2241.9	2439.2	1832.80-A
V2= NM-94	1103.8	1354.2	1639.1	1559.1	1875.9	2140.3	1611.73-B
Mean	1153.0-F	1463.0-E	1748.0-C	1622.0-D	2058.0-B	2290.0-A	-

S.E. for Treatment Mean					
	Varieties	**Fertilizer**	**V x F**	**S.E. / Plot**	**C.V %**
	10.3681	17.9582	25.3967	43.9883	2.55 %
Cd-1	**30.3518**	52.6700	74.4900	-	-
Cd-2	**41.3483**	71.5900	101.2000	-	-

DISCUSSION

In Pakistan, mostly nitrogenous fertilizers are applied, and less attention is given to the significance of phosphatic and potassic fertilizers; while the application of P is essential for maintaining the soil fertility. Phosphorus (P) is essential for plant growth it stimulates growth of young plants, giving them a good and vigorous start. Phosphorus management and nutrition has both economic and environmental implications. Phosphorus exists in soils in organic and inorganic forms. Organic forms of P are found in humus and other organic material. The process is most rapid in warm, well-drained soils. Research shows that 1% of the total soil organic phosphorus is mineralized per year during mung bean production. However, since initial levels are low, and plant uptake is only one possible fate of the mineralized phosphorus, the contribution by mineralization to plant available phosphorus is small (Anonymous, 2003)[1].

In the present study, seven NP combinations 0-0, 25-00, 25-50, 25-75, 50-00, 50-50 and 50-75 kg ha^{-1} were examined to evaluate their effect on seed germination, plant height, number of branches $plant^{-1}$, number of pods $plant^{-1}$, number of seeds $plant^{-1}$, weight of seed $plant^{-1}$, 1000 seed weight and seed yield kg ha^{-1}. The results showed that application of NP combination had significant ($P<0.01$) effect on all the above growth and seed yield contributing characters of mungbean and there was a linear and significant ($P<0.01$) effect of increasing P levels and highest NP combination of 50-75 kg ha^{-1} recorded maximum values for all the growth and yield components, closely followed by 50-50 NP combination ha^{-1}.

Kumar *et al.* (2002a) [14] examined the effect of different P levels in the research studies In conducted in India on mungbean .They applied P at 0, 20, 40 and 60 kg ha^{-1} There report are that number of branches, number of pods $plant^{-1}$, number of seeds pod^{-1}, 1000-seed weight and straw yield increased with increasing rates of P, whereas grain yield was highest under 40 kg P ha^{-1}. This little contradiction may have associated with the fertility of the experimental soil and overall environmental conditions, because our soils have severe deficiency of N followed by P. Similarly, in another study in India, Lukoki *et al.* (2000)[15] applied phosphorus at 0, 25, 50, and 75 kg ha^{-1} levels and obtained higher grain yield (764 kg ha^{-1}) with 25 kg P ha^{-1}, while in present study the yield level was well higher (>2290 kg ha^{-1}).under 50-75 kg ha^{-1}.

Whereas variety AEM-96 recorded maximum seed yield 1832.80 kg ha-1 than variety NM-94. But among the interactions the maximum seed yield 2439.2 kg ha^{-1} was recorded by interaction of NP kg ha^{-1} 50-75 and variety AEM-96 followed by the interaction NP kg ha^{-1} 50-50 x variety AEM-96 i.e. 2241.9 kg ha^{-1} whereas minimum seed yield kg ha^{-1} 1103.8 was recorded by the interaction of NP kg ha^{-1} 25.00 and variety NM-94.

Parsad *et al.* (2000) [16]applied phosphorus at 30, 60 and 90 kg ha^{-1} in mungbean and obtained highest seed yield with 60 kg P ha^{-1}, while Srinivas and Mohammad (2002) [17]concluded that plant height, number of branches and leaves $plant^{-1}$, number of pods $plant^{-1}$, pod length, number of seeds pod^{-1}, 1000-seed weight, and seed and haulm yield generally increased with increasing rates of P. In another study Thind *et al.* (2002)[18] recommended 90 kg P ha^{-1} for higher mungbean yield, while Patel *et al.* (2003)[7] obtained higher mungbean yields from P application upto 60 kg ha^{-1}.

Considerable research in Pakistan on the similar aspects has also been conducted. Nadeem *et al.* (2004)[19] reported that application of 60 kg P_2O_5 significantly increased the seed yield, while Goswami (2006) [20]examined 50, 75 and 100 kg ha^{-1} P levels and reported that 100 kg P ha^{-1} along with 75 kg N resulted in better growth and higher values in yield contributing characters.

The comparison of the values for growth and yield components obtained in the present investigation and results reported from other parts of the world on the similar aspect, it can be easily justified that 75 kg P ha^{-1} with 50 kg N ha^{-1} remained mostly optimum for getting higher economical mung bean yields in Tandojam conditions.

CONCLUSIONS

It was concluded from the findings of the present study that there was a linear and significant ($P<0.01$) effect of NP combination levels on the growth and seed yield kg ha^{-1}. The above trend of effectiveness makes it obvious that NP combination levels 50-75 kg ha^{-1} performed better seed yield production of variety AEM-96 under agro-climatic conditions of Tandojam.

REFERENCES

1. Anonymous. 2003. Agricultural Statistics of Pakistan 2002-2003, Government of Pakistan, Ministry of Food, Agriculture and Livestock, Agriculture and Livestock Division (Economic Wing), Islamabad. P.121.
2. Prasad, A.U., M.R. Singh and A.P. Singh. 1998. Yield, protein and nitrogen content and potassium uptake by summer moong as affected by water deficit and K application. Indian Agriculturist. 42 (1): 21-25.
3. Malik, M.A., S. Hussain, E.A. Warraich, A. Habib and S. Ullah. 2000. Effect of seed inoculation and phosphorus application on growth, seed yield and quality of mungbean (*Vignaradiata* L.) Cv. NM-98. International Journal of Agriculture and Biology. 4 (4): 515-516.
4. Abd-El-Lateef, E. M., N. I. Ashour and A.A. Farrag. 1998 a. Effect of foliar spray with urea and some micronutrients on mungbean (*Vignaradiata* L.) Wilczek growth, yield and seed chemical composition. Bulletin of the National Research Centre (Cairo), 23 (2): 219-232
5. Bamel, V., K.K.Verma and D.C. Gupta. 2002. Effect of different fertilizer forms on *Meloidogyne incognita* infecting mungbean (*Vignaradiata* L.). Proceedings of National Symposium on Biodiversity and Management of Nematodes in Cropping Systems for Sustainable Agriculture, Jaipur, India. Pp.240-244
6. Rajinder Kumar, Singh, V.P. and R.C. Singh. 2002. Effect of N and P application on nutrient content and their uptake and yield of summer planted mungbean. Research on Crops. 3 (3): 519-523
7. Patel, J.J., K.D. Mevada and R.L. Chotaliya. 2003. Response of summer mungbean to date of sowing and level of fertilizers. Source: Indian Journal of Pulses Research. 16 (2): 122-124.
8. Sharma, S., R.G. Upadhyay, C.R. Sharma and Rameshwar. 2003. Response of various levels of nitrogen and phosphorus application on growth, physiological parameters and yield of *Vignaradiata* (L.) under rainfed and mid-hill conditions of Himachal Pradesh. Indian Journal of Agricultural Research, 37 (1): 52-55

9. Tahir, M., M. A. Malik, A. Tanveer and R. Ahmad. 2003. Effect of NPK levels on crop yields. Pak. J. Life Soc. Sci., 1(2): 127-132.

10. Zeven, T. 1998. Effect of phosphorus on growth habit of mung bean. Fertilization of legumes, 5 (4): 114-117.

11. Singh, A.K., M. Singh and H. Ram. 2001. Effect of phosphorus and zinc fertilization chemical composition of mungbean, *Vignaradiata.* Journal of applied Biology. 3 (1-2): 28-32

12. Thakur, V.R. and D.G. Giri. 2001. Influence of different sources and level of phosphorus on yield uptake of Green gram, *Vignaradiata* L. Annals of plant physiology. Bhartiya Krishi Anusandhan Patrika, 11 (3): 136-140.

13. Kumar, R., V.P. Singh and R.C. Singh. 2002a. Effect of N and P fertilization on summer planted mung bean (*Vignaradiata* L.). Crop Research (Hisar), 24 (3): 467-470.

14. Lukoki, S., V. Marsui and H. Nakash. 2000. How the beans need phosphorus for stem and seed development. Legumes, 12 (1/2): 123-127.

15. Prasad, M.R., A.P Singh and B. Singh. 2000. Yield, water-use-efficiency and potassium uptake by summer mungbean as affected by varying levels of potassium and moisture stress. Journal of the Indian Society of Soil Science. 48 (4): 827-828.

16. Srinivas, M. and S. Mohammad. 2002. Performance of green gram [*Vignaradiata* (L.) and response functions as influenced by different levels of nitrogen and phosphorus. Crop Research (Hisar), 24 (3) : 458-462.

17. Thind, S.S., Manmohan Singh, A.S. Sidhu and I.M. Chhibba. 2002. Influence of continuous application of organic manures and nitrogen fertilizer on crop yield, N-uptake and nutrient status under maize-wheat rotation. Journal of Research, Punjab Agricultural University, 39 (3): 357-361.

18. Nadeem, M.A., Rashid Ahmad and M.S. Ahmad. 2004. Effects of seed inoculation and different fertilizer levels on the growth and yield of mung *Phaseolusaureus*. Journal of Agronomy, 3 (1): 40-42.

19. Goswami, D.R. 2006. Effect of NP fertilizers and sowing rates on the growth and yield of mung *Phaseolusaureus*. M.Sc. Thesis submitted to Sindh Agriculture University Tandojam, Pp. 1-65.