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Influence of Different Fertilizer Levels on the Growth and Productivity of Three Mungbean (*Vigna radiata* L.) Cultivars

RIAZ AHMAD, M. IKRAAM, EHSAN ULLAH AND ASIF MAHMOOD
Department of Agronomy, University of Agriculture, Faisalabad–38040, Pakistan

ABSTRACT

Response of three mungbean cultivars (NM-98, NM-36-13-1-2 and NM-46-7-2) to three fertilizer levels *viz*. 50-0-0, 50-100-0 and 50-100-50 kg NPK ha^{-1} was studied during the autumn, 2001. The experiment was conducted at Agronomic Research Area, University of Agriculture, Faisalabad. The results led to the conclusion that mungbean cultivar NM-46-7-2 applied 50-100 kg NP kg ha^{-1} produced more number of grains $plant^{-1}$, 1000-seed weight, grain yield and grain protein content than the other cultivars under study.

Key Words: *Vigna radiata;* NPK fertilizer; Cultivars

INTRODUCTION

Mungbean (*Vigna radiata* L.) is an important conventional pulse crop of Pakistan. Being rich source of protein (23-24%), it can play an important role to cover the protein shortage of poor masses (Rajput & Sarwar, 1988). It provides a balanced diet when taken in combination with wheat, rice and other cereals (Considine, 1982). It is a short duration and drought tolerant crop. It fits well in our existing crop rotation and can be grown twice in a year, both in spring and autumn seasons, in irrigated as well as rain-fed areas. Many farmers grow mungbean without applying any artificial fertilizer. Being a legume crop it requires less nitrogen but phosphorus and potassium are very vital nutrients to get its high yield. Moreover, different cultivars of mungbean have different potential and also varying response to different fertilizer levels.

Application of major nutrients, i.e. N, P and K improved mungbean yield (Ayyoub, 1985). Abbas (1994) reported that the application of 25-50-75 kg NPK ha^{-1} gave the highest yield of 1666 kg ha^{-1}. Rajput *et al*. (1992) observed that the application of 34-67-0 kg NPK ha^{-1} gave higher seed yield (803 kg ha^{-1}) of mungbean than 0-50-0 kg NPK ha^{-1} (694 kg ha^{-1}). Rao *et al*. (1993) applied 0, 25 and 50 kg P_2O_5 ha^{-1} to green gram cultivars and noted that seed yield, P uptake in seeds and haulms increased with P application. Hussain *et al*. (1996) concluded that fertilizer @ 30-90 kg NP ha^{-1} proved to be the best which produced the highest seed (835 kg ha^{-1}) and straw yield (5.72 t ha^{-1}) and heaviest 1000-seed weight (43.5 g). They also reported that cultivar NM-54 showed higher values for 1000-seed weight, seed and straw yields compared with NM-51.

Present study was designed to observe the effect of NPK application in different proportions on the yield potential of newly evolved mungbean cultivars under the irrigated conditions at Faisalabad.

MATERIALS AND METHODS

The experiment was conducted at the Agronomic Research Area, University of Agriculture, Faisalabad during autumn, 2001. The fertilizer combinations were 50-0-0, 50-100-0 and 50-100-50 kg NPK ha^{-1} while mungbean cultivars included in the experiment were NM-98, NM-36-13-1-2 and NM-46-7-2. Replicated three times the experiment was laid out in randomized complete block design (RCBD) with split plot arrangement. Fertilizer levels were randomized in main plots and mungbean cultivars in subplots. Net plot size was 2.4x7.0 m.

The crop was sown on a well prepared seed bed on July, 2001 in 40 cm spaced rows with the help of single row hand drill using a seed rate of 20 kg ha^{-1}. Plant to plant distance of 10 cm was maintained through thinning at 4-5 leaf stage. The entire quantity of fertilizer was side drilled after sowing in the respective plots. All the cultural practices were kept uniform for all the treatments. Data on number of plants m^{-2}, number of pods $plant^{-1}$, number of grains $plant^{-1}$, 1000-grain weight, grain yield and straw yield of mungbean cultivars were recorded using standard procedures. Grain nitrogen content was determined by kjeldahl's method (Jackson, 1964) and multiplied with the factor for getting crude protein content. The data collected were analyzed statistically using analysis of variance technique and Duncan's New Multiple Range Test at 5% probability level was employed to compare the differences among treatment means (Steel & Torrie, 1984).

RESULTS AND DISCUSSION

Number of plants m^{-2}. There were non-significant differences in number of plants m^{-2} (Table I) among the various fertilizer treatments which indicated that plant population per unit area was not affected by the application of fertilizer. The stand density on an average varied from 8.76 to 10.59 plants m^{-2} for the fertilizer treatments. The

Table I. Yield and yield components of three mungbean cultivars as affected by NPK application

Treatments	Number of plants m^{-2}	Number of pods $plant^{-1}$	Number of grains $plant^{-1}$	1000-grain weight	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Grain protein content (%)
A. Fertilizer							
NPK (kg ha^{-1})							
F_0 = control	8.76	17.07 c	145.0 c	55.20	835.5 c	1906.0 b	22.73 b
F_1 = 50-0-0	9.25	18.30 b	149.8 b	54.32	963.3 b	2036.0 b	22.85 b
F_2=50-100-0	8.97	19.17 a	153.3 a	56.06	1071.0 a	2291.0 a	23.71 a
F_3=50-100-50	10.59	18.96 a	157.4 a	55.80	1107.0 a	2428.0 a	22.36 b
LSD 0.05	NS	0.497	1.04	NS	105.2	201.1	0.576
B. Cultivar							
C_1 NM-98	8.69 b	17.82 c	150.0 b	46.72 c	853.7 c	2064.0 b	22.51 c
C_2 NM-36-13-1-2	9.28 b	18.17 b	150.4 b	57.36 b	956.3 b	2130.0 b	22.89 b
C_3 NM-46-7-2	10.55 a	19.13 a	156.8 a	61.95 a	1172.0 a	2302.0 a	23.33 a
LSD 0.05	0.96	0.298	1.84	1.035	38.88	122.6	0.370
C. FxC							
F_0C_1	7.2 e	16.67 e	140.5 g	46.58 d	682.22 h	1845.39 ef	22.79 cd
F_0C_2	8.04 de	18.23 de	145.1 f	58.57 bc	742.06 gh	1725.85 f	22.60 cd
F_0C_3	11.04 ab	17.30 d	149.4 e	60.44 b	1082.15 cd	2146.06 d	22.79 cd
F_1C_1	9.05 bcde	17.80 cd	144.5 f	45.99 d	797.13 g	1967.31 def	21.51 e
F_1C_2	10.24 abc	18.27 bc	150.2 de	56.52 c	1015.3 de	2115.36 de	23.15 bc
F_1C_3	8.47 cde	18.83 b	154.7 e	60.44 b	1077.55 cd	2026.04 de	23.88 ab
F_2C_1	6.61 cde	18.37 bc	155.7 bc	47.84 b	916.22 f	1993.20 de	23.15 bc
F_2C_2	8.64 cde	18.70 b	153.5 cd	56.96 c	940.86 ef	2072.02 de	23.73 ab
F_2C_3	11.0 ab	20.43 a	162.6 a	63.38 a	1356.76 a	2809.10 a	24.24 a
F_3C_1	9.9 abcd	18.43 bc	159.2 ab	46.48 d	1019.32 de	2451.65 bc	22.61 cd
F_3C_2	10.20 abcd	18.47 b	152.7 cde	57.38 c	1126.93 bc	2604.83 ab	22.06 de
F_3C_3	11.67 a	19.97 a	160.4 a	63.54 a	1173.48 b	2227.87 cd	22.42 cd
LSD	1.92	0.597	3.68	2.07	77.76	245.2	0.74

cultivars showed significant differences and NM-46-7-2 produced more number of plants m^{-2} (10.55) than NM-98 that produced (8.69) plants m^{-2}. Rajput *et al*. (1992) stated that there were significant differences in stand density among the cultivars. The interactive behavior of cultivars and fertilizer levels showed that maximum plant density m^{-2} was 11.67 by NM-46-7-2 fertilized @ 50-100-50 kg NPK ha^{-1} as against the minimum 7.2 in case of NM-98 without fertilizer application.

Number of pods $plant^{-1}$. Fertilizer levels had significant effect on the pod number (Table I). Application of NPK @ 50-100-0 kg ha^{-1} produced 10.95% more pods $plant^{-1}$ than control treatment (17.07). The number of pods $plant^{-1}$ varied significantly among different cultivars. NM-46-7-2 produced 7 and 5% more number of pods $plant^{-1}$ than NM-98 and NM-36-13-1-2, respectively. The interaction between cultivars and fertilizer levels showed significant results. NM-46-7-2 fertilized @ 50-100-0 kg NPK ha^{-1} produced the highest (20.43) number of pods $plant^{-1}$, whereas the lowest (16.67) were observed in NM-98 at control (0-0-0 kg NPK ha^{-1}). Ghildiya (1992), Rao *et al*. (1993) and Ali *et al*. (2000) reported the similar results.

Number of grains $plant^{-1}$. Fertilizer levels showed significant differences in the number of grains $plant^{-1}$ of mungbean cultivars (Table I). Fertilizer application @ 50-100-50 kg NPK ha^{-1} produced highest (157.4) number of grains plant. Number of grains $plant^{-1}$ increased in a linear order when N, P and K rates were increased. The cultivars also exhibited significant differences. NM-46-7-2 produced 4.34 and 4.08% more number of grains $plant^{-1}$ than NM-98 and NM-36-13-1-2, respectively. Interaction between fertilizer level and cultivars was found to be significant for this trait. NM-46-7-2 produced the highest (162.6) number of grains $plant^{-1}$ when fertilized @ 50-100-0 kg NPK ha^{-1}. Sharma and Room (1993) reported that yield components of mungbean were significantly affected by NPK, application.

1000-grain weight. The data (Table I) revealed that the fertilizer levels had non-significant effect on 1000-grain weight of mungbean. However, 1000-grain weight varied from 54.32 to 55.8 g for fertilizer treatments. On the other hand mungbean cultivars exhibited significantly different 1000-grain weight. Mungbean cultivar NM-46-7-2 produced the highest 1000-grain weight (61-95 g) while NM-98 produced the lowest grain weight (46.72 g). The variation in 1000-grain weight among different mungbean cultivars occurred due to varying genetic potential for this parameter. The interaction between both the factors under study was significant. NM-46-7-2 fertilized @ 50-100-50 kg NPK ha^{-1} produced larger 1000-grain weight (63.54 g) than when fertilized @ 50-100-0 kg NPK ha^{-1}. NM-98 produced significantly the lowest (45.99 g), 1000-grain weight with the application of 50-0-0 kg NPK ha^{-1}. These results are in conformity with those reported by Malik *et al*. (1990) who stated that 1000-grain weight and grain yield were greatly influenced by the application of fertilizer.

Grain yield. The crop sown with lower fertilizer levels produced lower yield and yield increased in a linear response when fertilizer rates were increased (Table I). A fertilizer dose @ 50-100-50 kg NPK ha^{-1} enhanced the grain yield up to 24.52% over control (835.5 kg ha^{-1}). It was followed by 50-100-0 kg NPK ha^{-1} which produced 22% more grain yield than control. The cultivars also varied

Table II. Net field benefits (Rs. ha^{-1}) of three mungbean cultivars as affected by different NPK levels

Treatment	Grain yield (kg ha^{-1})	Grain yield value (Rs ha^{-1})	Cost (Rs ha^{-1})	Net field benefit (RS ha^{-1})
A. Fertilizer				
NPK (kg ha^{-1})				
F_0 = control	835.5	16710	-	16710
F_1 = 50-0-0	963.3	19266	870	18396
F_2=50-100-0	1071.0	21420	3870	17550
F_3=50-100-50	1107.0	22140	4905	17235
B. Cultivar				
C_1 NM-98	853.7	17074	500	16574
C_2 NM-36-13-1-2	956.3	19126	500	18626
C_3 NM-46-7-2	1172.0	23440	500	22940
C. FXC				
F_0XC_1	682.2	13644	500	13144
F_0XC_2	742.1	14842	500	14342
F_0xC_3	1082.0	21640	500	21140
F_1xC_1	797.1	15942	1370	14572
F_1xC_2	1015.0	20300	1370	18930
F_1xC_3	1078.0	21560	1370	20190
F_2xC_1	916.2	18324	4370	13954
F_2xC_2	940.9	18818	4370	14448
F_2xC_3	1357.0	27140	4370	22770
F_3xC_1	1019.0	20380	5405	14975
F_3xC_2	1127.0	22540	5405	17135
F_3xC_3	1173.0	23460	5405	18055

Grain yield value; @ Rs. 800/40 kg; Nitrogen @ Rs. 17.4 kg^{-1}; Phosphorus @ Rs. 30 kg^{-1}; Potash @ Rs. 20.7 kg^{-1}; Seed @Rs. 25 kg^{-1}

significantly for grain yield. NM-46-7-2 produced 27.16 and 18.40% more grain yield compared with NM-98 and NM-36-13-1-2, respectively. The interaction between both the factors was significant. The most productive combination was 50-100-0 kg NPK ha^{-1} applied to NM-46-7-2. Singh *et al*. (1993) and Ali *et al*. (2000) reported the similar results to the above findings.

Straw weight. Straw weight was significantly influenced by the fertilizer treatments (Table I). The crop grown without fertilizer application (0-0-0 kg NPK ha^{-1}) produced lower straw weight. Straw weight increased in a linear order when fertilizer rates were increased. The highest straw yield 2428.0 kg ha^{-1} was observed with 50-100-50 kg NPK ha^{-1} which was at par with 50-100-0 kg NPK ha^{-1}. The cultivars showed significant differences in their straw weight. NM-46-7-2 produced 10.34 and 7.47% more straw weight than NM-98 and NM-36-13-1-2, respectively. Interaction between cultivars and fertilizers showed significant effect for this trait. NM-46-7-2 produced the highest straw weight (2809-1 kg ha^{-1}) when fertilized @ 50-100-0 kg NPK ha^{-1}. Hussain *et al*. (1996) concluded that N and P application had significant influence on straw weight of mungbean cultivars.

Grain protein content. Fertilizer levels had significant effect on grain protein content (Table I). The fertilizer level of 50-100-0 kg NPK ha^{-1} enhanced 6% more protein content in comparison with 50-100-50 kg NPK ha^{-1}. Similarly, the cultivars also had significant effect on grain protein content. NM-46-7-2 gave 3.51 and 2% highest protein content compared with NM-98 and NM-36-13-1-2, respectively. The interaction between the two factors was significant. The highest grain protein (24.24%) content was produced by NM-46-7-2 fertilized @ 50-100-0 kg NPK ha^{-1}. Badole *et al*. (1991) stated that protein percentage of *Vigna radiata* cv. TAP-7 was increased by supplying 50% of the recommended NPK fertilizer rated.

Economic analysis. Net field benefits (NFB) of mungbean as affected by different fertilizer levels and their interaction are given in Table II. The fertilizer level of 50-0-0 NPK kg ha^{-1} gave the maximum NFB of Rs.18396 ha^{-1} and control reflected NFB of Rs.16710 ha^{-1}. The fertilizer level of 50-0-0 kg NPK ha^{-1} caused 9 percent increase in NFB compared to control (Table II).

As regards cultivars, NM-46-7-2 gave the maximum NFB of Rs.22940 ha^{-1}, followed by NM-36-13-1-2, and NM-98, respectively. On the contrary, NM-98 resulted in the maximum NFB of Rs.16574 ha^{-1} (Table II). Slight differences in NFB among mungbean cultivars are ascribed to their varying grain yield ha^{-1}. Different treatment combinations also resulted in differential NFB (Table II). NM-46-7-2 fertilized @ 50-100-0 kg NPK ha^{-1} gave the maximum NFB (Rs. 22770 ha^{-1}) and the minimum NFB (RS. 13144 ha^{-1}) resulted in NM-98 without the fertilizer application. The highest NFB (Rs. 22770 ha^{-1}) was recorded for NM-46-7-2 fertilized @ 50-100-0 kg NPK ha^{-1}.

CONCLUSION

The mungbean cultivar cv. NM-46-7-2 proved to be the best as it produced the highest grain yield of 1356.76 kg ha^{-1} when fertilized @ 50-100-0 kg NPK ha^{-1}.

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