Journal of
Plant Sciences

ISSN 1816-4951

Academic
Journals Inc.

www.academicjournals.com

Journal of Plant Sciences 2 (2): 247-250, 2007
ISSN 1816-4951

Effect of Phosphorus Application and Time of Harvest on Yield and Quality of Moth bean [*Vigna aconitifolia* (Jecq.) Marechal]

Nishi Mathur, Joginder Singh, Sachendra Bohra, Avinash Bohra and Anil Vyas
Department of Botany, Microbial Biotechnology and Biofertilizer Laboratory,
J.N.V. University, Jodhpur, India-342 003

Abstract: An experiment consisting of three levels of phosphorus (0, 30, 60 kg P_2O_5 ha^{-1}) and six harvesting dates (starting from 20 days after flowering, at 5-day interval) was conducted at the field near Pal village, Jodhpur, Rajasthan (India) to assess their effects on yield and quality of moth bean. Application of 30 and 60 kg P_2O_5 ha^{-1} increased the mean seed yield by 5.8 and 9.7% over no phosphorus application. Harvesting moth bean at 20 Days After Flowering (DAF) gave a mean yield of 449 kg ha^{-1}. Seed yield progressively increased with delay in harvesting and was maximum when harvested at 40 DAF (705 kg ha^{-1}). A further delay of 5 days in harvesting (i.e., at 45 DAF) resulted in mean yield loss of 14%. Application of 60 kg P_2O_5 ha^{-1} resulted in higher split percentage (68.9%), more milling yield (82.5%), better husking efficiency (34.5%), higher head-dal yield (46.7%) and lower broken percentage (18.0%) as against 62.8, 78.9, 26.8, 37.2 and 22.0%, respectively, without the use of phosphorus. Better milling parameters were obtained when the crop was harvested at 30 DAF. Maximum crude protein was recorded when the crop was harvested at 35 DAF. Feeding trials on albino rats revealed that the pulse gave the maximum biological value of protein (47.05%) when the crop was harvested at 30 DAF with application of 60 kg P_2O_5. The biological value was lowest when phosphorus was not applied to the crop. Phosphorus application also resulted in increased value of net protein utilization. The study indicated that reasonable yield levels, milling parameters and protein quality could be obtained if the crop is harvested between 30 and 40 DAF.

Key words: Moth bean, phosphorus, time of harvest, milling quality, protein quality

INTRODUCTION

Grain legumes provide vegetarians with a significant amount of their dietary protein requirements. Even In case of non-vegetarians, legumes remain to be major source of proteins (Mertia *et al*., 2006; Guillon and Champ, 1996). These are good sources of vitamins and minerals in addition to calories and proteins (Duranti and Gius, 1997). Moth bean (*Vigna aconitifolia* (Jecq.) Marechal) is an important crop of arid regions. However, effect of fertilizers and other agronomic practices on quality parameters has not been investigated in detail (Bhansali *et al*., 2004). The grain moisture content is supposed to have a definite bearing on field and post-harvest losses, storability and milling quality of pulses. The information available on effect of agronomic practices on post harvest aspects of pulses, though important, yet is meagre (Singh, 2005). This investigation was, therefore, aimed to find out optimum harvest period besides phosphorus needs and their effects on grain yield, milling characters and protein quality with respect to time of harvest.

Corresponding Author: Anil Vyas, Department of Botany, Microbial Biotechnology and Biofertilizer Laboratory, J.N.V. University, Jodhpur, India-342 003 Tel: 011-291-2430226

MATERIALS AND METHODS

An experiment was conducted at field near Pal village, Jodhpur, Rajasthan (India), for three consecutive kharif seasons on loamy sand soil having pH 8.3, organic carbon 0.24% and total nitrogen 0.06%, available phosphorus 18 kg ha^{-1} and available potassium 230 kg ha^{-1}. The soil contained 86% sand, 8.2% silt and 5.6% clay and has been classified as coarse loamy, mixed, hyperthermic, camborthids according to US soil taxonomy.

A split plot design with three replications was used keeping moth bean cultivar RMO-40 as test crop Three levels of phosphorus (0, 30 and 60 kg P_2O_5 ha^{-1}) in main plots and six harvesting dates (starting from 20 days after flowering at 5-day interval) were kept in sub-plots Whole of phosphorus as per treatments and 15 kg N ha^{-1} as starter dose were applied at the time of sowing Short spell of droughts occurred during season I at early crop stage, while during season II and III at reproductive stage and as such one supplemental irrigation (40 mm) at these stages was given in every season.

Total N in seed was determined by modified Kjeldhal method, which was multiplied by factor (6.25) to obtain crude protein content. Moth bean samples from with or without phosphorus application treatments harvested at 30 and 45 days after flowering were evaluated for protein quality by conducting feeding trials on albino rats. The collected samples were analyzed for biological value of protein (BY), True Digestibility (TD), Apparent Digestibility (AD) and Net Protein Utilization (NPU) as per Eggum (1973). The data were statistically analyzed in split plot design as per Gomez and Gomez (1984). The milling parameters were obtained with single run of laboratory model of grinding mill run by 1 HP motor

RESULTS AND DISCUSSION

Grain Yield

Application of 30 and 60 kg P_2O_5 ha^{-1} increased the mean seed yield by 5.8 and 9.7% over no phosphorus application. The poor response of moth bean to applied phosphorus was due to low rainfall and drought conditions in all the seasons.

Harvesting moth bean at 20 Days After Flowering (DAF) gave a mean yield of 449 kg ha^{-1} (Table 1). Seed yield progressively increased up to harvesting at 40 DAF (705 kg ha^{-1}). Thus, delay in harvesting by another 20 days resulted in increased yield by 58.8% over 20 DAF. Garg *et al*. (2004) reported that seeds in pod attain maximum dry weight up to 19-21 days after anthesis in moth bean. Increase in yield after 20 DAF in the present study is attributed to non-synchronous pod development in green gram. Therefore the grain yields are maximum when the grain development is complete in most of tile pods. A delay of 5 days in harvesting (at 45 DAF) resulted in mean yield loss of 14%.

Table 1: Influence of phosphorus and time of harvest on moth bean yield (kg ha^{-1})

Treatments	Season I	Season II	Season III	Mean
P_2O_5 levels				
0	946	220	495	553
30	982	276	507	588
60	946	329	545	606
LSD (0.05)	80	18	15	-
Time of Harvest (DAF)				
20	520	330	499	449
25	602	302	545	483
30	980	210	561	583
35	1140	270	565	658
40	1336	320	459	705
45	1175	230	429	613
LSD (0.05)	61	23	20	-

DAF: Days after flowering

The phosphorus application increased the pod number. Application of 60 kg P_2O_5 ha^{-1} resulted in 8.5% higher pods $plant^{-1}$ over control (0 kg P_2O_5 ha^{-1}). The number of pods at 20 days after flowering was 16.9 per plant, which increased to 31.8 per plant when crop was harvested at 40 days after flowering. A delay in harvesting by 5 days from 40 days after flowering led to 27.8 pods per plant (14% loss of pods). The reduction in yield at delayed harvesting was mainly due to loss of pods owing to over maturity. Walsh (1991) while reviewing the causes of grain loss in mung bean found delayed harvesting as major cause of grain loss in Australia.

Milling Quality

Phosphorus application marginally improved the milling quality parameters. Application of 60 kg P_2O_5 ha^{-1} resulted in higher split percentage (68.9%), more milling yield (82.5%), better husking efficiency (34.5%), higher head-dal (dehusked split) yield (46.7%) and lower broken percentage (18.0%) as against 62.8, 78.9, 26.8, 37.2 and 22.0%, respectively, without the use of phosphorus (Table 2). Harvesting moth bean at 30 DAF gave better split percentage, higher total milling yield, better husking efficiency, higher head-dal yield and lower broken percentage compared to earlier or delayed harvesting which gave poor milling quality parameters (Table 2). The poor milling characters in early harvesting may be attributed to pre-mature grain, while in delayed harvesting low grain moisture content played a key role in deteriorating milling parameters. The fast drying of grains caused very low moisture contents in grain in later harvesting, which led to higher breakage of grains which eventually led to lower husking efficiency. Better yield at 40 DAF and better milling parameters at 30 DAF defines a 10-day period, i.e., between 30 and 40 DAF where reasonable yields with satisfactory milling characters could be obtained.

Crude Protein Content

Application of phosphorus and time of harvest had no significant effect on the crude protein content. However, crude protein (25.5%) was maximum when crop was harvested at 35 DAF with application of 60 kg P_2O_5. Singh *et al.* (1994) also found increased crude protein contents in seeds of moth bean with the application of 60 kg P_2O_5 ha^{-1}.

Protein Quality

Maximum biological value of protein (47.5%) was obtained when moth bean was harvested at 30 DAF with 60 kg P_2O_5 ha^{-1} while harvesting at 30 DAF without phosphorus resulted in the lowest biological value (44.02%). This indicates positive role of P application in enhancing protein quality. On an average the application of phosphorus increased the biological value from 45.08% under control to 46.62% with 60 kg P_2O_5 ha^{-1} (Table 3). Application of phosphorus also resulted in increased value

Table 2: Influence of phosphorus and harvesting time on milling parameters (mean of 3 seasons) of moth bean

Treatments	Split percentage	Milling yield (%)	Husking efficiency (%)	Head-dal yield (%)	Broken percentage
Phosphorus level (kg ha^{-1})					
0	62.8	78.9	26.8	37.2	22.1
30	64.2	82.4	39.6	42.0	19.7
60	68.9	82.5	34.5	46.7	18.0
Harvesting time (DAF)					
20	61.1	78.1	31.3	39.4	21.9
25	63.7	80.7	33.2	42.2	19.2
30	68.8	83.5	34.3	45.4	17.3
35	65.2	82.1	28.1	40.2	18.4
40	65.1	79.7	28.0	39.1	20.9
45	63.7	75.9	26.7	35.9	23.1

Table 3: Protein quality of moth bean (%) as influenced by phosphorus and time of harvest (mean of 3 seasons)

	Days after flowering		
Phosphorus (kg ha^{-1})	30	45	Mean
Biological value of protein			
0	44.02	46.15	45.08
60	47.05	46.20	46.62
Mean	45.53	46.17	-
Net protein utilization			
0	30.22	34.12	32.17
60	33.08	33.31	33.19
Mean	31.65	33.71	-
True digestibility			
0	70.63	76.84	73.73
60	71.56	72.95	72.25
Mean	70.59	74.89	-
Apparent digestibility			
0	54.02	59.03	56.52
60	54.14	55.26	54.70
Mean	54.08	57.14	-

of net protein utilization. The True Digestibility (TD) and Apparent Digestibility (AD), however, decreased with application of phosphorus. Delay in harvesting from 30 to 45 DAF improved protein quality characters at both phosphorus levels except those of biological value and net protein utilization, which were higher at 30 DAF with 60 kg P_2O_5 ha^{-1} application.

REFERENCES

Bhansali, A.K., B.R. Choudhary, S.R. Kumhar and M.M.C. Bhandari, 2004. Stability of seed yield and other traits in mothbean [*Vigna aconitifolia* (Jacq.) Marechal]. J. Arid Legumes, 1: 95-97.

Duranti, M. and C. Gius, 1997. Legume seeds: Protein content and nutritional value. Field Crops Res., 53: 31-45.

Eggum, B.O., 1973. A Study of Certain Factors Influencing Protein Utilization in Rats and Pigs. Beretning fra forsogstaborats rict, Kobenhvnv, pp: 135-147.

Garg, D.K., R.K. Kakani and V.S. Deora, 2004. Genetic variation in drought response of moth bean [*Vigna aconitifolia* (Jacq.) Marechal] genotypes in target environment. J. Arid Legumes, 1: 44-47.

Gomez, K.A. and A.A. Gomez, 1984. Statistical Procedures for Agricultural Research. John Wiley and Sons, New York, pp: 49.

Guillon, F. and M. Champ, 1996. Grain legumes and transit in humans. Grain Legumes, 11: 18.

Mertia, R.S., B.K. Khandpal and R.N. Kumawat, 2006. Comparative performance of moth bean (*Vigna aconitifolia*) varieties under rainfed condition. J. Arid Legumes, 3: 15-18.

Singh, H., P.S. Rathore and A.L. Mali, 1994. Influence of phosphate and inoculation on nutrient uptake, recovery and response of applied P on green gram (*Phaseolus radiatus*). Indian J. Agron. 39: 316-318.

Singh, B., 2005. Adoption gap in mung bean and moth bean production technology in arid zone of Rajasthan. Ann. Arid Zone, 44: 109-110.

Walsh, P.A., 1991. Grain harvest loss in mung bean: A review. Agricultural Engineering Australia, 20: 11-19.