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# Response of different levels of FYM, phosphorus and nitrogen on yield, nutrients uptake, physicochemical properties of soil after harvest and economics of mothbean [*Vigna aconitifolia* L.]

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**Abstract**
The field experiment was conducted at Regional Research Station, S.D. Agricultural University, Bhachau, Kachchh to evaluate the effect of different levels of FYM, phosphorus and nitrogen on yield and economics of moth bean [*Vigna aconitifolia* L.] during *Kharif* season of 2017-18, 2019-20 and 2020-21. The experiment consists of eighteen treatment combinations comprised of two FYM levels [0 t/ha (F0) and 2.5 t/ha (F1) combined with three phosphorus levels [0 kg $P_2O_5$/ha ($P_0$), 20 kg $P_2O_5$/ha (P1) and 40 kg $P_2O_5$/ha (P2)] along with three levels of nitrogen [0 kg N/ha ($N_0$), 20 kg N/ha (N1) and 40 kg N/ha (N2)]. Phosphorus applied in the form of PROM and nitrogen in form of urea. The experiment was laid out in factorial RBD with three replications. The results revealed that seed and stover yields of moth bean were significantly increased by the FYM, phosphorus and nitrogen treatments. The increased in seed yield due to F1 over F0 (698 kg/ha) increased in seed yield by 13.46 per cent. The treatment P2 and P1 over P0 (776 kg/ha) was 21.92 and 13.51 per cent, respectively and treatment N2 and N1 over N0 (783 kg/ha) was increased 23.35 and 10.93, respectively. Similar trend in stover yield was noted by FYM, phosphorus and nitrogen treatments. The interaction of P X N effect was significant on seed and Stover yields indicate that nutrient use efficiency of P was higher when phosphorus was applied along with organic FYM @ 2.5 t/ha and nitrogen @ 20 kg N/ha. The interaction of P X N effect was significant on seed and stover yields indicate that nutrient use efficiency of P was higher when phosphorus was applied along with organic FYM @ 2.5 t/ha and nitrogen @ 20 kg N/ha. Treatment combination F1P2N2 (FYM @ 2.5 t/ha, 40 kg $P_2O_5$/ha and 20 kg N/ha) was obtained significantly higher nutrients uptake by seed and stover. Available nutrients in the soil after harvest are best in the F1P2N2 (FYM @ 2.5 t/ha, 40 kg $P_2O_5$/ha and 20 kg N/ha) maintained the soil physico-chemical properties. The application of FYM @ 2.5 t/ha with phosphorus @ 40 kg $P_2O_5$/ha and nitrogen @ 20 kg N/ha secured the higher net realization of 23853, 26076 and 23626 /ha, respectively.

**Keywords:** Mothbean, yields, nutrients uptake and physico-chemical properties, economics

## 1. Introduction

Mothbean [*Vigna aconitifolia* (Jacq.) Marechal] is an important pulse crop of the desert region and is remarkably well suited to arid and semi-arid areas of India and some other countries of Asia. In India, it is grown on an area of 13.19 lakh ha, mostly confined to Rajasthan, Gujarat, Maharashtra, Karnataka, Uttar Pradesh and Haryana with a production of 1,753 lakh t and productivity of 133 kg $ha^{-1}$ (Rajendra Prasad, 2013) [11]. It can very well withstand drought conditions and is probably the most drought resistant crop among the grain legumes. Mothbean is a short duration, deep rooted legume recognized for its twin benefits of tolerance for drought and heat. It has ability to grow under harsh climate, low rainfall and poor soil conditions and considered as most significant arid pulse of Rajasthan (Sharma and Ratnoo, 2014) [14]. The crop has spreading growth habit forming a mat like covering on the soil surface. It thus helps greatly in the conservation of soil, water and serves as a very efficient and suitable cover crop for checking soil erosion. The lower productivity of this crop is attributed to several factors *viz*., growing the crop under moisture stress, marginal lands with very low inputs, without proper nutrient management and other agronomical practices, without pest and disease management, non-availability of high yielding varieties and late sowing. This clearly shows that it is necessary to overcome these constraints to get higher yields. Yield is a complex character resulting from the interplay of nutrient management with the environmental variables and other factors. Balanced fertilization is necessary to increase the productivity of pulses. Regular and judicious use of fertilizers not only helps in raising good crop yield, but also can help farmers to gain consistently higher profit. But even today, a great number of farmers are not smearing recommended dose of fertilizers. As a consequence of technological dissemination farmers have realised importance of use of nitrogen, phosphorus, secondary or trace elements and organic manures. Price escalation of fertilizers has also been a factor that prevents the farmers from using optimum quantities of fertilizers.

Vasanthi and Subramanian (2004) [20] observed the maximum nitrogen, phosphorous and potassium concentration and their uptake with the incorporation of vermicompost @ 2 t ha-1 + 100% RDF. Indoria *et al.* (2005) [4] preached that supply of nitrogen 10 kg ha$^{-1}$ and phosphorous 40 kg ha$^{-1}$ resulted in momentous upsurge in uptake of nitrogen (49.3 and 46.7 kg ha-1) and phosphorous (7.57 and 7.19 kg ha-1, respectively) by grain and straw of cowpea as contrast to control. However, Yadav *et al*. (2015) at Udaipur, revealed that highest uptake of nutrient was recognised with combined supply of RDF 100% + VC @ 4 t per ha. The combined incorporation of vermicompost with 100% RDF significantly improved the status of nitrogen, phosphorous and potassium content over the chemical fertilizer alone. With the increasing demand of pulses, there is an urgent need to increase their productivity, so combined use of fertilizers and organic manure not only give the great promise in crop production but also control the emergence of multiple nutrient deficiencies and maintain good soil health. Keeping this in view, an effort was made to investigate the effect of integrated nutrient management on yield and uptake of nutrients by mothbean (*Vigna acontifolia*) in northern dry zone of Karnataka.

## 2. Materials and Methods

The experiment was conducted at Regional Research Station, S.D. Agricultural University, Bhachau, Kachchh, to study the effect of different treatments on yield, nutrients uptake and physico-chemical properties of soil after harvest of moth bean (*Vigna aconitifolia* L.) during *Kharif* season of 2017-18, 2019-20 and 2020-21. The soil was sandy loam and low in organic matter. The soil pH was 8.03 and having organic carbon (0.27 %), available nitrogen (172.48 kg ha-1) and available phosphorus (36.60 kg ha-1) and medium in potassium (308.40 kg ha-1). Total eighteen treatment combinations comprising of all possible treatments of two levels of FYM *viz.*, F0 (0 t/ha) and F1 (2.5 t/ha), three levels of phosphorus *viz.*, P0 (0 kg P2O5/ha), P1 (20 kg P2O5/ha) and P2 (40 kg P2O5/ha) and three levels of nitrogen *viz.*, N0 (0 kg N/ha), N1 (20 kg N/ha) and N2 (40 kg N/ha) were tested in factorial RBD with three replications. Moth bean variety GMO-2 was sown by opening furrow at distance of 45 cm. The full dose of fertilizers was applied according to the treatments manually before sowing the seeds. Phosphorus and nitrogen were applied in form of PROM and urea, respectively. All the recommended cultural practices and plant protection measures were followed throughout the experimental periods. For estimation of nitrogen, phosphorus and potassium content and uptake in moth bean, composite samples of whole plant were taken after harvest and ground to powder which was used for the chemical analysis. Nitrogen was estimated by Kjeldahl's method (Jackson, 1967), phosphorus was estimated by Vanadomolydo phosphoric acid yellow colour method (di-acid extract), potassium was estimated by using the flame photometer (Jackson, 1967) and sulphur was estimated by Turbidimetric method (Chaudhary and Cornfield, 1966). The total uptake of nitrogen, phosphorus, potassium and sulphur were calculated by using given formula.

$$\text{Nutrient uptake (kg/ha)} = \frac{\text{Nutrient content (\%) x Yield (kg/ha)}}{100}$$

The soil samples were randomly drawn from different spots of experimental site up to 30 cm depth composite sample was prepared after proper mixing, drying and sieving. Soil physico-chemical properties were analysed by using the following methods.

**Table 1**: Methods used for estimation of physico-chemical properties of the soil.

| **Soil pH (1:2.5)** | **Potentiometric method** | **Jackson (1967)** |
|---|---|---|
| EC (dSm$^{-1}$) (1:2.5) at 25 °C | Conductometric method | Jackson (1967) |
| Bulk density (Mg/m$^3$) | Core method | Piper (1950) |
| Available N (kg ha$^{-1}$) | Alkaline Potassium permanganate | Subbiah and Asija (1956) |
| Available $P_2O_5$ (kg ha$^{-1}$) | Extraction with 0.5 M $NaHCO_3$ (pH 8.5) Colorimetric method | Olsen *et al.* (1954) |
| Available $K_2O$ (kg ha$^{-1}$) | Flame photometeric method | Richards (1954) |
| Available sulphur (mg kg$^{-1}$) | 1% NaCl extraction method | Williams and Steinberg (1959) |

## 3. Results and Discussion

The results obtained from the present investigation as well as relevant discussion have been summarized under following headings.

### Effect of FYM

Significantly higher grain yield (918, 761, 695 and 792 kg/ha) and stover yield (1536, 1461, 1404 and 1467 kg/ha) were reported with incorporation of FYM @ 2.5 t/ha (F1) during 2017-18, 2019-20, 2020-21 and in pooled results, respectively (Table 2). This increment attributed to amplified growth probably as a consequence of effective use of nutrients absorbed through ramified root system and productive shoot growth due to amended nourishment through organics fertilization and it also might be due to application of organics which improves the physico-chemical and biotic properties of soil which in turn benefited plants by providing balanced nutrition to crop as and when needed which helped in production of a greater number of yield parameters and ultimately increased the moth bean yield. These results are conformity with those reported by Patel *et al*. (2019) [14], Ruheentaj *et al*. (2020) [19], Patel *et al*. (2020) [13] and Arunakumar and Uppar (2007) [1]. Results from the Table 5 and 6 indicated that highest nitrogen (30.58 and 12.31 kg/ha), phosphorus (2.01 and 2.66 kg/ha), potassium (12.07 and 35.91 kg/ha), sulphur

(2.23 and 142.9 kg/ha), iron (1216 and 2763 g/ha) and zinc (157.8 and 229.8 g/ha) uptake by seed and stover were recorded significantly highest when crop was fertilized with FYM @ 2.5 t/ha (F1) in pooled results. This result was agreement with research results of Kumar *et al*. (1994) [9] and Waigwa *et al*. (2003) [29] There are different treatments had significant effect on soil fertility status. At the end of third year of experiments the available N (176.1 kg/ha), P2O5 (37.42 kg/ha), K2O (270.0 kg/ha) and S (10.80 ppm) was significantly influenced by FYM @ 2.5 t/ha (Table 7). Soil organic matter affects soil fertility and the C and N mineralization capacity of the soil, which determines the availability of plant nutrients. Continuous application of FYM increases the level of N, P, K and S in the soil over the year. Thus creating a reservoir of soil nutrients for several years after application, use of FYM might have attributed to mineralization of N in soil and due to high enzyme activities in the soil amended with organic manures might have increased the transformation of nutrients to available form.

The highest net returns of 23853 /ha were obtained with application of FYM @ 2.5 t/ha (F1). While lowest value 23721 /ha was recorded with FYM @ 0 t/ha (F0). In case of BCR, the highest value of 2.73 was recorded under FYM @ 0 t/ha (F0) and it was followed by FYM @ 2.5 t/ha (F1). It might be due to less cost of cultivation incurred and more net returns obtained under FYM @ 0 t/ha (F0) as compaired to other treatment [Table-8]. This result was agreement with research results of Raj Singh (2008) [16], Sadashivanagowda *et al*. (2017), Patel *et al*. (2020) [13] and Ruheentaj *et al*. (2020) [19].

**Effect of Phosphorus**

Among different phosphorus levels, the higher seed yield (942, 781, 714 and 812 kg/ha) and stover yield (1585, 1507, 1451 and 1514 kg/ha) were noticed with the supply of phosphorus @ 40 P2O5 kg/ha (P2) during 2017-18, 2019-20, 2020-21 and in pooled results, respectively (Table 2). The reason to such stimulating effect of phosphorus may be assigned to the fact that phosphate is a constitutes of many intermediates products of legumes crop and considered as an essential constituent of all living organisms and plays an important role in conservation and transfer of energy in metabolic reactions of living cells including biological energy transformations. Thus, application of increasing levels of phosphorus may have enhanced cell division, root elongation and proliferation of roots. Thereby more absorption of nutrients and moisture from deeper layer of soil could have taken place. Several reports indicated that cell division is increased with application of phosphorus, as a result of which growth is enhanced in legumes. These findings are in concordant with Patel *et al*. (2019) [14], Patel *et al*. (2020) [13], Singh *et al*. (2017) [24], Meena *et al*. (2010) [11] and Arunakumar and Uppar (2007) [1]. Data presented in Table 5 and 6 indicated that highest nitrogen (31.26 and 12.51 kg/ha), phosphorus (2.27 and 2.89 kg/ha), potassium (11.65 and 35.02 kg/ha), sulphur (2.15 and 139.4 kg/ha), iron (1177 and 2693 g/ha) and zinc (153.1 and 224.6 g/ha) uptake by seed and stover were recorded significantly highest when crop was fertilized with 40 kg P2O5/ha through PROM (P2) on pooled data basis. This result was agreement with research results of Kumar *et al*. (1994) [9] and Waigwa *et al*. (2003) [29]. The significantly highest available P2O5 in soil (40.11 kg/ha) was recorded under application of phosphorus @ 40 kg/ha through PROM over other levels of phosphorus, but in case of available N, K2O and S showed did not significant effect through sources of Phosphorus. These results regarding physico-chemical properties of the soil are in line with the findings made by Vyas *et al*. (2003) [28] and Katkar *et al*. (2005) [7].

The highest net returns of 26076 /ha were obtained with application of phosphorus @ 40 kg P2O5/ha (P2). While lowest value 20898 /ha was recorded with 0 kg P2O5/ha (P0). In case of BCR, the highest value of 2.53 was recorded under 20 kg P2O5/ha (P1). and it was followed by 40 kg P2O5/ha (P2). It might be due to less cost of cultivation incurred and more net returns obtained under 20 kg P2O5/ha (P1) as compared to other treatment [Table-8]. This result was agreement with research results of Kokani *et al*. (2014) [8], Himani *et al*. (2017) [3], Patel *et al*. (2020) [13] and Ruheentaj *et al*. (2020) [19].

**Effect of Nitrogen**

It is evident from the data presented in Table 2 that significantly higher seed yield (955, 794, 725 and 824 kg/ha) and stover yield (1586, 1510, 1448 and 1515 kg/ha) were obtained with application of 40 kg N/ha (N2) from urea during 2017-18, 2019-20, 2020-21 and in pooled results, respectively. This increment was attributed due to supply of nitrogen and phosphorus, resulted in amplified photosynthetic activity and helps to develop a ramified root system and thus empowers the plant to withdraw extra water and nutrient from deeper layers, resulted in better growth and yield attributes. Present results are in concordant with the finding of Saraswathy *et al*. (2004) [21] in green gram, Indoria and Majumdar (2007) [5] in cowpea and Trivedi (1996) [26] in black gram. Results from the Table 5 and 6 indicated that highest nitrogen (32.98 and 13.19 kg/ha), phosphorus (2.05 and 2.63 kg/ha), potassium (11.92 and 35.36 kg/ha), sulphur (2.19 and 140.3 kg/ha), iron (1192 and 2687 g/ha) and zinc (154.7 and 223.8 g/ha) uptake by seed and stover were recorded significantly highest when crop was fertilized with 40 kg N/ha through urea (N2) in pooled results. This result was agreement with research results of Kumar *et al*. (1994) [9] and Waigwa *et al*. (2003) [29]. On the pooled data basis, after final harvesting of moth bean, the significantly highest available N in soil (180.7 kg/ha) was recorded in application of nitrogen @ 40 kg/ha through urea over other levels of nitrogen, but in case of available P2O5, K2O and S showed did not significant effect through sources of nitrogen. These results regarding physicochemical properties of the soil are in line with the findings made by Vyas *et al*. (2003) [28] and Katkar *et al*. (2005) [7].

The data given in [Table-4] indicated that the highest net realization of 27838 /ha and BCR the value of 2.73 was secured with application of 40 kg N/ha (N2) from urea in mothbean it was followed by application of 20 kg N/ha (N1). It is mainly due to the increased yield with comparatively less additional cost of nitrogen under these treatments. This result was agreement with research results of Kokani *et al*. (2014) [8], Himani *et al*. (2017) [3] and Patel *et al*. (2020) [13].

**Interaction Effect**

Data presented in Table 5 revealed that treatment combination of P2N2 (40 kg P2O5/ha with 40 kg N/ha) recorded significantly the higher nitrogen, phosphorus, potash, sulphur, iron and zinc uptake by seed (36.81, 2.56, 13.18 and 2.42 kg/ha with 1326 and 172 g/ha, respectively) whereas treatment combination of F1P2 (FYM @ 2.5 t/ha with 40 kg P2O5/ha) recorded significantly the higher phosphorus, potassium, sulphur, iron and zinc uptake by seed (2.45, 12.98 and 2.41 kg/ha with 1302 and 169 g/ha, respectively). Also data presented in Table 5 obtained that treatment combination of F1N2 (FYM @ 2.5 t/ha with 40 kg N/ha) recorded significantly the higher sulphur uptake by seed (2.48 kg/ha) whereas treatment combination of F1P2N2(FYM @ 0 t/ha with 40 kg P2O5/ha and 40 kg N/ha) recorded significantly the higher sulphur and zinc uptake by seed (2.68 kg/ha and 188.18 g/ha) as compared to rest of the treatment combinations during in pooled results. Present findings were in accordance with the study conducted by Patel *et al*. (2019) [14] and Ruheentaj *et al.* (2020) [19] Data presented in Table 6 revealed that treatment combination of F1P2 (FYM @ 2.5 t/ha with 40 kg P2O5/ha) recorded significantly the higher nitrogen, potassium, sulphur, iron and zinc uptake by stover (13.60, 38.92 and 156 kg/ha with 3003 and 250 g/ha, respectively) whereas treatment combination of P2N2 (40 kg P2O5/ha with 40 kg N/ha) recorded significantly the higher nitrogen, phosphorus, potassium, sulphur, iron and zinc uptake by stover (15.08, 3.27, 39.62 and 158 kg/ha with 3054 and 255 g/ha, respectively) and also revealed that treatment combination of F1P2N2 (FYM @ 2.5 t/ha with 40 kg P2O5/ha and 40 kg N/ha) recorded significantly the higher phosphorus, potash, sulphur, iron and zinc uptake by stover (3.62, 43.23 and 174.09 kg/ha with 3354 and 279 g/ha, respectively compared to rest of the treatment combinations during in pooled results. The results was agreement with Sharma *et al* (2024) [22].

## Conclusion

From the results of experimentation, it can be concluded that moth bean (GMO-2) should be fertilized with application of FYM @ 2.5 t/ha along with 40 kg P2O5/ha through PROM and 20 kg N/ha from urea under light textured soil of Kachchh region for getting higher yield, nutrients uptake, maintained soil fertility and yield profit (net realization) and BCR.

**Table 2:** Seed yield and stover yield of moth bean as influenced by different treatments

| Treatment | Seed yield (kg/ha) | | | | Stover yield (kg/ha) | | | |
|---|---|---|---|---|---|---|---|---|
| | 2017-18 | 2019-20 | 2020-21 | Pooled | 2017-18 | 2019-20 | 2020-21 | Pooled |
| **FYM Levels (F)** | | | | | | | | |
| $F_0$ | 815 | 670 | 608 | 698 | 1317 | 1245 | 1190 | 1251 |
| $F_1$ | 918 | 761 | 695 | 792 | 1536 | 1461 | 1404 | 1467 |
| S.Em.± | 17 | 20 | 20 | 11 | 53 | 46 | 40 | 27 |
| C.D. at 5% | 49 | 57 | 59 | 31 | 153 | 133 | 116 | 76 |
| **Phosphorus Levels (P)** | | | | | | | | |
| $P_0$ | 776 | 640 | 582 | 666 | 1236 | 1176 | 1124 | 1179 |
| $P_1$ | 881 | 726 | 660 | 756 | 1458 | 1376 | 1317 | 1384 |
| $P_2$ | 942 | 781 | 714 | 812 | 1585 | 1507 | 1451 | 1514 |
| S.Em.± | 21 | 24 | 25 | 14 | 65 | 57 | 49 | 33 |
| C.D. at 5% | 61 | 69 | 72 | 38 | 187 | 163 | 142 | 93 |
| **Nitrogen Levels (N)** | | | | | | | | |
| $N_0$ | 783 | 640 | 581 | 668 | 1265 | 1189 | 1137 | 1197 |
| $N_1$ | 861 | 713 | 649 | 741 | 1428 | 1360 | 1306 | 1365 |
| $N_2$ | 955 | 794 | 725 | 824 | 1586 | 1510 | 1448 | 1515 |
| S.Em.± | 21 | 24 | 25 | 14 | 65 | 57 | 49 | 33 |
| C.D. at 5% | 61 | 69 | 72 | 38 | 187 | 163 | 142 | 93 |
| **FxP Interaction** | | | | | | | | |
| S.Em.± | 30 | 34 | 35 | 19 | 92 | 80 | 70 | 47 |
| C.D. at 5% | NS | NS | NS | NS | NS | NS | NS | NS |
| **FxN Interaction** | | | | | | | | |
| S.Em.± | 30 | 34 | 35 | 19 | 92 | 80 | 70 | 47 |
| C.D. at 5 % | NS | NS | NS | NS | NS | NS | NS | NS |
| **PxN Interaction** | | | | | | | | |
| S.Em.± | 36 | 42 | 43 | 24 | 113 | 98 | 85 | 57 |
| C.D. at 5 % | NS | NS | NS | 66 | NS | NS | NS | 161 |
| **FxPxN Interaction** | | | | | | | | |
| S.Em.± | 52 | 59 | 61 | 33 | 159 | 139 | 121 | 81 |
| C.D. at 5 % | NS | NS | NS | NS | NS | NS | NS | NS |
| **YxT Interaction** | NS | | | | NS | | | |
| C.V. % | 10.31 | 14.34 | 16.33 | 13.39 | 19.36 | 17.78 | 16.11 | 17.92 |

**Table 3:** Combined effect of phosphorus and nitrogen on seed yield of moth bean (Pooled)

| | $P_0$ | $P_1$ | $P_2$ | Mean |
|---|---|---|---|---|
| $N_0$ | 629 | 687 | 688 | 668 |
| $N_1$ | 651 | 728 | 844 | 741 |
| $N_2$ | 717 | 851 | 905 | 824 |
| Mean | 666 | 756 | 812 | |
| S.Em. ± 23.51 | | C.D. at 5% 65.93 | | |

**Table 4:** Combined effect of phosphorus and nitrogen on stover yield (kg/ha) of moth bean (Pooled)

| | $P_0$ | $P_1$ | $P_2$ | Mean |
|---|---|---|---|---|
| $N_0$ | 1108 | 1238 | 1244 | 1197 |
| $N_1$ | 1159 | 1335 | 1600 | 1365 |
| $N_2$ | 1269 | 1577 | 1699 | 1515 |
| Mean | 1179 | 1384 | 1514 | |
| S.Em.± 57.38 | | C.D. at 5% 160.95 | | |

**Table 5:** Nutrient uptake by seed of moth bean as influenced by different treatments (pooled)

| Treatment | N (kg/ha) | P (kg/ha) | K (kg/ha) | S (kg/ha) | Fe (g/ha) | Zn (g/ha) |
|---|---|---|---|---|---|---|
| **FYM Levels (F)** | | | | | | |
| $F_0$ | 25.8 | 1.62 | 9.18 | 1.70 | 919 | 119 |
| $F_1$ | 30.6 | 2.01 | 12.07 | 2.23 | 1216 | 158 |
| S.Em.± | 0.24 | 0.02 | 0.09 | 0.02 | 9.95 | 1.17 |
| C.D. at 5% | 0.67 | 0.04 | 0.26 | 0.04 | 27.90 | 3.29 |
| **Phosphorus Levels (P)** | | | | | | |
| $P_0$ | 24.7 | 1.27 | 9.45 | 1.73 | 948 | 123 |
| $P_1$ | 28.6 | 1.91 | 10.78 | 2.01 | 1076 | 140 |
| $P_2$ | 31.3 | 2.27 | 11.65 | 2.15 | 1177 | 153 |
| S.Em.± | 0.29 | 0.02 | 0.11 | 0.02 | 12.18 | 1.44 |
| C.D. at 5% | 0.82 | 0.05 | 0.31 | 0.05 | 34.17 | 4.03 |
| **Nitrogen Levels (N)** | | | | | | |
| $N_0$ | 23.0 | 1.60 | 9.36 | 1.73 | 947 | 123 |
| $N_1$ | 28.6 | 1.79 | 10.61 | 1.97 | 1063 | 138 |
| $N_2$ | 33.0 | 2.05 | 11.92 | 2.19 | 1192 | 155 |
| S.Em.± | 0.29 | 0.02 | 0.11 | 0.02 | 12.18 | 1.435 |
| C.D. at 5% | 0.82 | 0.05 | 0.31 | 0.05 | 34.17 | 4.025 |
| **FxP Interaction** | | | | | | |
| S.Em.± | 0.41 | 0.03 | 0.16 | 0.03 | 17.23 | 2.03 |
| C.D. at 5% | NS | 0.07 | 0.442 | 0.071 | 48.328 | 5.692 |
| **FxN Interaction** | | | | | | |
| S.Em.± | 0.41 | 0.03 | 0.16 | 0.03 | 17.23 | 2.03 |
| C.D. at 5 % | NS | NS | NS | 0.071 | NS | NS |
| **PxN Interaction** | | | | | | |
| S.Em.± | 0.51 | 0.03 | 0.19 | 0.03 | 21.1 | 2.49 |
| C.D. at 5 % | 1.420 | 0.09 | 0.541 | 0.086 | 59.2 | 6.972 |
| **FxPxN Interaction** | | | | | | |
| S.Em.± | 0.72 | 0.05 | 0.27 | 0.04 | 29.84 | 3.52 |
| C.D. at 5 % | NS | NS | NS | 0.122 | NS | 9.860 |
| YxT Interaction | NS | NS | NS | NS | NS | NS |
| C.V. % | 7.62 | 7.51 | 7.70 | 6.66 | 8.39 | 7.61 |

**Table 6:** Nutrients uptake by stover of moth bean as influenced by different treatments (pooled)

| Treatment | N (kg/ha) | P (kg/ha) | K (kg/ha) | S (kg/ha) | Fe (g/ha) | Zn (g/ha) |
|---|---|---|---|---|---|---|
| **FYM Levels (F)** | | | | | | |
| $F_0$ | 9.76 | 1.99 | 26.890 | 106.4 | 2020 | 168.1 |
| $F_1$ | 12.31 | 2.66 | 35.911 | 142.9 | 2763 | 229.8 |
| S.Em.± | 0.10 | 0.02 | 0.255 | 1.120 | 19 | 1.7 |
| C.D. at 5% | 0.27 | 0.06 | 0.716 | 3.141 | 53 | 4.7 |
| **Phosphorus Levels (P)** | | | | | | |
| $P_0$ | 9.38 | 1.74 | 27.211 | 106.7 | 2059 | 170.4 |
| $P_1$ | 11.21 | 2.35 | 31.966 | 127.9 | 2421 | 202.0 |
| $P_2$ | 12.51 | 2.89 | 35.024 | 139.4 | 2693 | 224.6 |
| S.Em.± | 0.12 | 0.02 | 0.313 | 1.372 | 23 | 2.1 |
| C.D. at 5% | 0.34 | 0.07 | 0.877 | 3.847 | 65 | 5.8 |
| **Nitrogen Levels (N)** | | | | | | |
| $N_0$ | 8.90 | 2.01 | 27.251 | 108.1 | 2083 | 173.4 |
| $N_1$ | 11.02 | 2.33 | 31.591 | 125.6 | 2404 | 199.7 |
| $N_2$ | 13.19 | 2.63 | 35.359 | 140.3 | 2687 | 223.8 |
| S.Em.± | 0.12 | 0.02 | 0.313 | 1.372 | 23 | 2.1 |
| C.D. at 5% | 0.34 | 0.07 | 0.877 | 3.847 | 65 | 5.8 |
| **FxP Interaction** | | | | | | |
| S.Em.± | 0.17 | 0.03 | 0.442 | 1.940 | 33 | 2.9 |
| C.D. at 5% | 0.47 | NS | 1.241 | 5.441 | 92 | 8.2 |
| **FxN Interaction** | | | | | | |
| S.Em.± | 0.17 | 0.03 | 0.442 | 1.940 | 33 | 2.9 |
| C.D. at 5 % | NS | NS | NS | NS | NS | NS |
| **PxN Interaction** | | | | | | |
| S.Em.± | 0.21 | 0.04 | 0.542 | 2.376 | 40 | 3.6 |
| C.D. at 5 % | 0.58 | 0.12 | 1.519 | 6.664 | 113 | 10.0 |
| **FxPxN Interaction** | | | | | | |
| S.Em.± | 0.29 | 0.06 | 0.766 | 3.360 | 57 | 5.0 |
| C.D. at 5 % | NS | 0.17 | 2.149 | 9.424 | 160 | 14.1 |
| YxT Interaction | NS | NS | NS | NS | NS | NS |
| C.V. % | 7.95 | 7.64 | 7.32 | 8.09 | 7.2 | 7.6 |

**Table 7:** Available nutrients in soil after harvest of moth bean as influenced by different treatments (pooled)

| Treatment | N (kg/ha) | $P_2O_5$ (kg/ha) | $K_2O$ (kg/ha) | S (ppm) | EC (dS/m) | pH |
|---|---|---|---|---|---|---|
| **FYM Levels (F)** | | | | | | |
| $F_0$ | 167.0 | 32.87 | 231.9 | 9.320 | 0.804 | 8.24 |
| $F_1$ | 176.1 | 37.42 | 270.0 | 10.80 | 0.802 | 8.18 |
| S.Em.± | 1.63 | 0.35 | 2.19 | 0.13 | 0.00 | 0.03 |
| C.D. at 5% | 4.57 | 0.99 | 6.15 | 0.36 | NS | NS |
| **Phosphorus Levels (P)** | | | | | | |
| $P_0$ | 169.1 | 29.46 | 250.6 | 9.928 | 0.809 | 8.24 |
| $P_1$ | 170.9 | 35.86 | 250.2 | 10.12 | 0.802 | 8.20 |
| $P_2$ | 174.7 | 40.11 | 252.0 | 10.13 | 0.799 | 8.18 |
| S.Em.± | 2.00 | 0.43 | 2.69 | 0.14 | 0.00 | 0.04 |
| C.D. at 5% | NS | 1.210 | NS | NS | NS | NS |
| **Nitrogen Levels (N)** | | | | | | |
| $N_0$ | 158.2 | 34.70 | 247.7 | 9.897 | 0.799 | 8.23 |
| $N_1$ | 175.9 | 35.13 | 251.6 | 10.14 | 0.804 | 8.20 |
| $N_2$ | 180.7 | 35.61 | 253.6 | 10.14 | 0.807 | 8.18 |
| S.Em.± | 2.00 | 0.43 | 2.69 | 0.16 | 0.00 | 0.04 |
| C.D. at 5% | 5.60 | NS | NS | NS | NS | NS |
| **FxP Interaction** | | | | | | |
| S.Em.± | 2.82 | 0.61 | 3.80 | 0.22 | 0.01 | 0.05 |
| C.D. at 5% | NS | NS | NS | NS | NS | NS |
| **FxN Interaction** | | | | | | |
| S.Em.± | 2.82 | 0.61 | 3.80 | 0.22 | 0.01 | 0.05 |
| C.D. at 5 % | NS | NS | NS | NS | NS | NS |
| **PxN Interaction** | | | | | | |
| S.Em.± | 3.46 | 0.75 | 4.65 | 0.27 | 0.01 | 0.07 |
| C.D. at 5 % | NS | NS | NS | NS | NS | NS |
| **FxPxN Interaction** | | | | | | |
| S.Em.± | 4.88 | 1.06 | 6.58 | 0.38 | 0.01 | 0.10 |
| C.D. at 5 % | NS | NS | NS | NS | NS | NS |
| YxT Interaction | NS | NS | NS | NS | NS | NS |
| C.V. % | 8.55 | 9.02 | 7.86 | 11.33 | 4.04 | 3.48 |

**Table 8:** Effects of different treatments on economics of Mothbean

| Treatments | Seed yield (kg/ha) | Stover yield (kg/ha) | Gross realization (₹/ha) | Cost of cultivation (₹/ha) | Net Realization (₹/ha) | BCR (%) |
|---|---|---|---|---|---|---|
| **FYM Levels (F)** | | | | | | |
| F0 | 698 | 1251 | 37379 | 15060 | 23721 | 2.73 |
| F1 | 792 | 1467 | 42511 | 20060 | 23853 | 2.28 |
| **Phosphorus Levels (P)** | | | | | | |
| P0 | 666 | 1179 | 35656 | 14760 | 20898 | 2.46 |
| P1 | 756 | 1384 | 40544 | 17560 | 24386 | 2.53 |
| P2 | 812 | 1514 | 43634 | 20360 | 26076 | 2.52 |
| **Nitrogen Levels (N)** | | | | | | |
| N0 | 668 | 1197 | 35797 | 17300 | 19897 | 2.29 |
| N1 | 741 | 1365 | 39784 | 17560 | 23626 | 2.49 |
| N2 | 824 | 1515 | 44254 | 17820 | 27838 | 2.73 |

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