# RESPONSE OF DHAINCHA (*Sesbania aculeata* L.) TO SPACING AND NUTRIENT MANAGEMENT UNDER SOUTH GUJARAT CONDITION

**CHAUDHARI, M. P., PATEL, D. D.*, MISS PATEL R. D., PATEL D. K., PATEL T. U. AND PATEL, H. K.**

**N. M. COLLEGE OF AGRICULTURE**
**NAVSARI AGRICULTURAL UNIVERSITY**
**NAVSARI – 396 450, GUJARAT, INDIA**

***Email: drpatel_76@yahoo.co.in***

## *ABSTRACT*

***A field experiment was conducted during rabi season of the year 2010-2011 at College Farm, Navsari Agricultural University, Navsari (Gujarat) to study "Response of dhaincha (Sesbania aculeata L.) to spacing and nutrient management under South Gujarat condition". Sixteen treatment combinations consisting of two levels of spacing, 45 cm x 10 cm and 60 cm x 10 cm, two levels of inorganic fertilizers, 75 per cent RDF and 100 per cent RDF, and four levels of biofertilizer, no biofertilizer, Rhizobium (Azorhizobium caulinodans), Phosphate solubilizing bacteria (Bacillus coagulans) and combination of Rhizobium (Azorhizobium caulinodans) + Phosphate solubilizing bacteria (Bacillus coagulans) were evaluated in split-split plot design with three replications. The results revealed that rabi dhaincha grown for seed production at 60 cm × 10 cm spacing and fertilized with 100 per cent RDF (25:50:00 NPK/ha) along with seed inoculation with Rhizobium (Azorhizobium caulinodans) @ 10 ml/kg seed + phosphate solubilizing bacteria (Bacillus coagulanns) @ 10 ml/kg under South Gujarat condition gave higher yield and monetary returns.***

***KEY WORDS:*** *Biofertilizer, dhaincha, nutrient management, spacing*

## INTRODUCTION

Dhaincha (*Sesbania aculeata* L.) is a plant of sub-order fabales of order leguminoseae. It is an annual shrub cultivated as multipurpose legume especially for its fine fibre in many countries including India. The crop is grown also for legume or as a fodder.

Proper spacing provides sufficient interception of light and satisfactory absorption of nutrients and water from the soil due to the proper development of root system and results in higher crop yield of *Sesbania aculeata*. Nutrient management is an age old concept in traditional agriculture because of the low nutrient turns over in soil plant system (Meelu and Singh, 1991). Nutrient management approach involving inorganic fertilizers, biological sources and organic manure will go a long way in building soil fertility on sustainable basis, since the system will supply almost all the nutrients in a judicious way, besides increasing the nutrient use efficiency and improving the physico-chemical properties of soil. Very little work has been done on nutrient requirement for dhaincha, when grown as a seed crop.

Dhaincha being a leguminous crop utilizes atmospheric nitrogen through symbiotic nitrogen fixation to meet a major part of its nitrogen requirement. The seed inoculation with proper strain of biofertilizer is the low cost input for enhancing crop yields. Phosphorus solubilizes the native phosphorus by the secretion of organic acid. Inoculation with phosphate solubilizing bacteria alone increased the grain yield of dhaincha by about 8.3 per cent than that of no inoculation (Meena *et al.*, 2001). Considering the above facts and views, the present experiment was planned.

## MATERIALS AND METHODS

A field experiment was conducted during *rabi* season of the year 2010-2011 at College Farm, Navsari Agricultural University, Navsari (Gujarat) to study the "Response of dhaincha (*Sesbania aculeata* L.) to spacing and nutrient management under South Gujarat condition". The soil of the experimental field was clayey in texture, low in available nitrogen (232.50 kg/ha), medium in available phosphorus (32.00 kg/ha) and fairly rich in available potassium (350.00 kg/ha) with 7.8 soil pH. Sixteen treatment combinations consisting of two levels of spacing as main plot i.e., $S_1$: 45 cm x 10 cm and $S_2$: 60 cm x 10 cm, two levels of inorganic fertilizers as sub plot viz., 75 per cent RDF ($F_1$) and 100 per cent RDF ($F_2$) and four levels of biofertilizer as sub-sub plot viz., No biofertilizer ($B_0$), *Rhizobium* (*Azorhizobium caulinodans*) ($B_1$), Phosphate solubilizing bacteria (*Bacillus coagulans*) ($B_2$) and *Rhizobium* (*Azorhizobium caulinodans*) + Phosphate solubilizing bacteria (*Bacillus coagulans*) ($B_3$) were evaluated in split-split plot design with three replications. Recommended dose of fertilizer (RDF) was 25: 50: 00 NPK kg/ha. Other cultural practices and plant protection measures were taken as per recommendations. The data on plant height, number of branches / plant, dry matter accumulation / plant and number of pods / plant were recorded from five randomly selected plants in each net plot, while seed yield was recorded from net plot and converted on hectare basis. The data were analyzed statistically by adopting the standard procedures described by Panse and Sukhatme (1967).

## RESULT AND DISCUSSION

### *Effect of Spacing*

Plant height and number of root nodules per plant did not differ significantly due to various spacing (Table 1). So, far number of branches per plant is concerned, significantly maximum number of branches per plant was recorded with $S_2$ (60 cm) treatment. This might be due to better nourishment and availability of sufficient space under wider spacing. Similar results were reported by Patil *et al*. (1997) in cowpea and Ulemale *et al*. (2003) in sunnhemp. The result revealed that spacing $S_2$ (60 cm) registered significantly higher values for yield and almost all the yield attributing characters as compared to spacing $S_1$ (45 cm) (Table 2). Higher number of pods per plant (59.68) observed in spacing $S_2$ (60 cm) as compared to spacing $S_1$ (45 cm) (51.58). The maximum number of pods per plant in wider spacing might be attributed to relatively less inter-plant competition because of more space availability to individual plants. Number of seed per pod and 1000 seed weight were not significantly affected by spacing. These two plant characters are largely genetically governed and are not affected much by culture practices. Similar observations also made by Ulemale *et al*. (2001) in sunnhemp and Yadav (2003) in cowpea. The results reported in Table 2 showed significantly the highest seed and straw yield with $S_2$ (60 cm) as compared to $S_1$ (45 cm). The higher values for almost all the yield attributes were observed under wider spacing of $S_2$ (60 cm). Hence, wider spacing $S_2$ (60 cm) resulted in to significantly the highest seed and straw yields. These findings were corroborated the results of Ulemale and Shivankar (2003) and Lamani *et al*. (2004) in sunnhemp and Kumar *et al*. (2005) in Dhaincha with respect to seed yield and Yadav (2003) in cowpea with respect to seed and straw yield. Maximum net return of ₹.

88684/ha and BCR value of 5.4 was recorded under $S_2$ (60 cm) spacing over $S_1$ (45 cm), which recorded net return of ₹. 79811/ha with BCR value of 4.7. This was due to higher yield of seed and straw registered under $S_2$ (60 cm) spacing. Similar results were also reported by Kumar (2004) in cowpea.

***Effect of inorganic fertilizer***

The plant height and root nodules per plant of dhaincha did not differ significantly due to various levels of inorganic fertilizer. Treatment receiving 100 per cent RDF ($F_2$) resulted into maximum number of branches per plant (Table 1) at harvest. It was due to adequate amount of inorganic fertilizers i.e. 100 per cent RDF, which results in prolonged supply of nutrients. The similar results were reported by Ulemale *et al*. (2003) in sunnhemp and Ambhore (2004) in greengram. The yield and yield attributes viz., number of pods per plant, number of seeds per pod and test weight (Table 1) were recorded significantly higher values under treatment receiving 100 per cent RDF ($F_2$) over 75 per cent RDF ($F_1$) treatment. This was largely attributed to better growth of plant in terms of plant height, number of branches per plant, which resulted in adequate supply of photosynthates for development of sink under adequate level of inorganic fertilizers. Positive response in terms of yield attributes to inorganic fertilizers have also been reported by Ulemale *et al.* (2003) in sunnhemp with respect to number of pods per plant; Patel and Patel (1994) in greengram with respect to number of seeds per pod and Rajkhowa *et al*. (2002) in greengram with respect to test weight. Treatment receiving 100 per cent RDF ($F_2$) produced significantly the highest seed yield (1520 kg/ha) over other treatment $F_1$. The increases in seed yield might be due to remarkable improvement in the yield attributes and growth parameters. The results were supported by the findings of Rengalakshmi and Purshothman (1999) in dhaincha, Kumar *et al.* (2005) and Shastri *et al.* (2007) in sunnhemp and Sharma *et al.* (2003) in greengram. Straw yield remained unaffected by various inorganic fertilizers (Table 2). However, numerically increase in straw yield with application of 100 per cent RDF ($F_2$) was observed as compared to 75 per cent RDF ($F_1$). The net return of ₹. 86645/ha with BCR value of 4.8 was obtained under treatment receiving 100 per cent RDF ($F_2$) as against the net return of ₹. 80018/ha and BCR of 4.5 with 75 per cent RDF ($F_1$) treatment (Table 2). This was due to higher yield in $F_1$, ultimately reflected into higher net realization and BCR. Similar results were also reported by Ambhore (2004) in greengram and Kumar *et al*. (2005) in sunnhemp.

***Effect of biofertilizer***

Plant height and number of branches per plant were significantly maximum with *Rhizobium* (*Azorhizobium caulinodans*) + phosphate solubilizing bacteria (*Bacillus coagulans*) inoculation ($B_3$) over phosphate solubilizing bacteria (*Bacillus coagulans*) ($B_2$), *Rhizobium* (*Azorhizobium caulinodans*) ($B_1$) and no biofertilizer ($B_0$) at harvest. These results confirmed the findings of Jain and Singh (2003) in legumes and Rathore *et al*. (2007) in clusterbean. Treatment *Rhizobium* (*Azorhizobium caulinodans*) + phosphate solubilizing bacteria (*Bacillus coagulans*) inoculation ($B_3$) produced significantly the highest number of root nodules per plant at 30, 45 and 60 DAS over ($B_0$). The *Rhizobium* (*Azorhizobium caulinodans*) + phosphate solubilizing bacteria (*Bacillus coagulans*) inoculation ($B_3$) were remained at par with phosphate solubilizing bacteria (*Bacillus coagulans*) ($B_2$) and *Rhizobium* (*Azorhizobium caulinodans*) ($B_1$) at 45 DAS with this character. This might be higher population of *Rhizobium* (*Azorhizobium caulinodans*) and phosphate solubilizing bacteria (*Bacillus coagulans*) and they lived in root nodules, their symbiotic relationship with plants and hence number of root nodules increases ultimately with *Rhizobium* (*Azorhizobium caulinodans*) + phosphate solubilizing bacteria (*Bacillus coagulans*) inoculation. The present results are in accordance with those reported by Ramamoorthy and Aroklaraj (1997) in greengram and Kumar *et al.* (2007) in clusterbean. Significant boost up in number of pods per plant and test weight were noted with treatment *Rhizobium* (*Azorhizobium caulinodans*) + phosphate solubilizing bacteria (*Bacillus coagulans*) inoculation ($B_3$), which was statistically at par with phosphate solubilizing bacteria (*Bacillus coagulans*) inoculation ($B_2$). Similar results were obtained by Nagaraja and Nanjudappa (1996) in cowpea and Ramamoorthy and Aroklaraj (1997) in greengram. Significantly the highest seed yield (1729 kg/ha) and straw yield (9071 kg/ha) were recorded with *Rhizobium* (*Azorhizobium caulinodans*) + phosphate solubilizing bacteria (*Bacillus coagulans*) inoculation ($B_3$) over no inoculation ($B_0$). This might be due to significant and progressive effect of *Rhizobium* (*Azorhizobium caulinodans*) + phosphate solubilizing bacteria (*Bacillus coagulans*) inoculation on yield attributes viz., number of pods per plant and test weight. These results corroborated the findings of Jain and Singh (2003) in gram and Nagar and Menna (2004) in clusterbean. There was an appreciable increased in net realization due to biofertilizer. The highest net return of ₹. 101270/ha with BCR value of 6.0 was obtained with *Rhizobium* (*Azorhizobium caulinodans*) + phosphate solubilizing bacteria (*Bacillus coagulans*) inoculation ($B_3$). This was due to comparatively better increase in yield with $B_3$ (1729 kg/ha) treatment over $B_2$ (1546 kg/ha), $B_1$ (1361 kg/ha) and $B_0$ (1236 kg/ha). These results are in accordance with the findings of Bhalu *et al*. (1995) in blackgram and Singh *et al*. (2004) in legumes.

## CONCLUSION

Based on the results from the experimentation, it seemed quite logical to conclude that *rabi* dhaincha (var. Local) should be grown with 60 × 10 cm spacing and fertilized with 100 per cent RDF (25-50 kg NP/ha) along with Rhizobium + phosphate solubilizing bacteria seed inoculation under South Gujarat condition for getting higher yield and monetary returns.

## REFERENCES

Ambhore, A. P. (2004). Response of summer greengram (*Vigna radiata* L.) to biofertilizers and inorganic fertilizers under South Gujarat conditions. M.Sc. (Agri.) Thesis submitted to Navsari agricultural University, Navsari.

Bhalu, V. B., Sadaria, S. G., Kaneria, B. B. and Khanpara, V. D. (1995). Effect of nitrogen, phosphorus and *Rhizobium* inoculation on yield and quality of N and P uptake and economics of blackgram (*Phaseolus mungo*). Indian J. Agron., **40** (2): 316 -318.

Jain, L and Singh, P. (2003). Growth and nutrient uptake of chickpea (Cicer arietinum L.) as influenced by biofertilizers and phosphorus nutrition. Crop Res., **25**(3): 410-413.

Kumar. B. G. (2004). Response of summer cowpea [(*Vigna unguiculata* (L.)] to row spacing and weed management under South Gujarat conditions. M.sc (Agri) thesis submitted to N.A.U., Navsari: 93

Kumar, C. J., Hiremath, S. M., Chittapur, B. M. and Chimmad, V. P. (2005). Effect of sowing time and fertilizer levels on seed production of sunnhemp in transitional zone of Karnataka. *Karnataka J. Agril. Sci*., **18**(3): 594-598.

Kumar, S., Baboo, R. and Kumar, M. (2007). Response of guar (*Cyamopsis tetragonoloba* L.) to *rhizobium* inoculation, nitrogen and phosphorus. *Progressive Agric*., **7** (1-2): 147-148.

Lamani, K. D., Rajkumara, S. and Parameshwarappa, S. G. (2004). Effect of seed rate and spacing on seed sunhemp in different seasons. *Karnataka J. Agril. Sci*, **17** (2): 234-237.

Meelu, O. P and Singh, Y. (1991). Intergrated use of fertilizers and organic manures for higher returns. *Prog. Fing., Punjab Agriculture. Univ*., **27**: 3-4.

Meena, K. N., Pareek, R. G and Jat, R. S. (2001). Effect of phosphorus and biofertilizers on yield and quality of chickpea (Cicer arietinum L.). *Annals of Agril. Res. New Series*, **22** (3): 388-390.

Nagar, K. C. and Meena, N. L. (2004). Effect of phosphorus sulphur and phosphate solubilizing bacteria on yield components, yield and quality of clusterbean (*Cyamopsis tetragonobha* L.). *Legume Res.*, **27** (1): 27-31.

Nagaraju, A. P. and Nanjundappa, G. (1996). Effect of sources and levels of Phosphorus using P-solubilizing inoculants on cowpea (*Vigna unguiculata* (L.) Walp). *Crop Res*., **12** (3): 387-389.

Panse, V. G. and Sukhatme, P. V. (1967). Statistical Methods for Agricultural Workers, ICAR, New Delhi, pp: 1-22.

Patel, J. R. and Patel, Z. G. (1994). Effect of foliar fertilization of nitrogen and phosphorus on growth and yield of summer greengram (Vigna radiata L.). *Indian J. Agron*., **39** (4):578-580.

Patil, N. K. B., Kumannuvar, P. Y. and Biradar, D. P. (1997). Performance of Cowpea verities at two inters row spacing. *J. Maharastra Agril.Univ*., **16** (1):11-112.

Rajkhowa, D. J., Saikia, M. and Rajkhowa, K. M. (2002). Effect of vermicompost with and without fertilizer on greengram. Legume Res., **25** (4): 295-396.

Ramamoorthy, K. and Aroklaraj A. (1997). Agronomic effectiveness of organic sources and mussorie rock phosphate to phosphorus economy in rainfed greengram. *Madras Agric. J.*, **84** (10) : 593-595.

Rathore, V. S., Singh, J. P., Soni, M. L., Yadava, N. D. and Beniwal, R. K. (2007). Productivity,quality and resource utilization by clusterbean (*Cyamopsis tetragonoloba* (Linn) Taub.) as influenced by nutrient management. Indian J. Agron., **77** (6): 349-353.

Rengalakshmi, R. and Purshothman, S. (1999). Effect of season, spacing and phosphorus on seed producation *Sesbania* species. *Madras Agric. J.*, **86** (4-6): 232-235.

Sharma, S., Upadhyay, R. G., Sharma, C. R. and Rameshwar. (2003). Response of various levels of nitrogen and phosphorus application on growth, physiological parameters and yield of [*Vigna radiata* (L.) Wilczek] under rainfed and mid-hill conditions of Himachal Pradesh. Indian J. Agril. Res., **37** (1): 52-55.

Shastri, A. B., Desai, B. K., Pujari, B. T., Halepyati, A. S. and Vasudevan, S. N. (2007). Studies on the effect of plant densities and phosphorus management on growth and seed yield of sunnhemp (*Crotalaria juncea* L.). *Karnataka J. Agril. Sci*., 20(2): 359-360.

Singh, R., Singh, B. and Saxena, A. (2004). Response of clusterbean [*Cyamopsis tetragonoloba* (L). Taub.] to nutrient management under arid condition of Rajasthan. *J. Arid Legumes*, **1**(1): 32-34.

Ulemale, R. B. Giri, D. G. and Shivankar, R. S. (2001). Effect of sowing dates, row spacing and phosphate level on biomass studies in Sunnhemp. J. Maharashtra Agril. Univ., 26 (3): 323-325.

Ulemale, R. B. and Shivankar, R. S. (2003). Effect of sowing dates, row spacing and phosphate level on yield and economics of sunnhemp. Legume Res., **26** (1): 71-72.

Ulemale, R. B., Giri, D. G.; Shivankar, R. S. and Patil, V. N. (2003). Effect of sowing dates, spacing and phosphate levels on growth and productivity of sunnhemp. *Legume Res*., **26** (2): 121-124.

Yadav, G. L. (2003). Effect of sowing time, row spacing and seed rate on yield of cowpea under rainfed condition. *Indian J. Pulses Res*., **16** (2): 157-158.

**Table 1: Growth parameters and yield attributes of *rabi* dhaincha as influenced by various treatments**

| Treatment | Plant Height (cm) | Number of Branches per Plant | Number of Root Nodules per Plant | | | No. of Pods per Plant | No. of Seeds per Pod |
|---|---|---|---|---|---|---|---|
| | | | 30 DAS | 45 DAS | 60 DAS | | |
| **Spacing (S)** | | | | | | | |
| $S_1$ = 45cm | 214.70 | 6.49 | 25.78 | 35.73 | 34.93 | 51.58 | 28.37 |
| $S_2$ = 60cm | 222.94 | 8.09 | 27.00 | 37.00 | 36.18 | 59.68 | 29.45 |
| S. Em. ± | 3.28 | 0.18 | 0.53 | 0.53 | 0.57 | 1.33 | 0.92 |
| C.D. (P=0.05) | NS | 1.10 | NS | NS | NS | 8.09 | NS |
| C.V. % | 7.35 | 12.16 | 9.88 | 7.23 | 7.97 | 11.72 | 13.57 |
| **Inorganic Fertilizer (F)** | | | | | | | |
| $F_1$ = 75 % RDF | 214.47 | 6.77 | 25.31 | 35.27 | 34.56 | 53.57 | 27.70 |
| $F_2$ = 100 % RDF | 223.18 | 7.80 | 27.47 | 37.47 | 36.54 | 57.70 | 30.12 |
| S. Em. ± | 3.13 | 0.11 | 0.56 | 0.59 | 0.55 | 0.87 | 0.43 |
| C.D. (P=0.05) | NS | 0.45 | NS | NS | NS | 3.43 | 1.71 |
| C.V. % | 7.01 | 7.76 | 10.51 | 7.97 | 7.59 | 7.70 | 6.37 |
| **Biofertilizer (B)** | | | | | | | |
| $B_0$ = No Bio fertilizer | 214.0 | 5.97 | 23.80 | 33.72 | 32.88 | 51.15 | 26.66 |
| $B_1$ = *Rhizobium* | 216.72 | 6.96 | 26.05 | 37.60 | 35.17 | 53.63 | 28.33 |
| $B_2$ = PSB | 219.75 | 7.77 | 27.13 | 37.70 | 36.58 | 57.43 | 29.75 |
| $B_3$ = *Rhizobium* + PSB | 224.76 | 8.52 | 28.58 | 38.58 | 37.58 | 60.31 | 30.91 |
| S. Em. ± | 1.04 | 0.17 | 0.40 | 0.43 | 0.37 | 1.17 | 0.80 |
| C.D. (P=0.05) | 3.05 | 0.49 | 1.17 | 1.27 | 1.08 | 3.43 | NS |
| **Interaction** | | | | | | | |
| S X F | NS | NS | NS | NS | NS | NS | NS |
| S X B | NS | NS | NS | NS | NS | NS | NS |
| F X B | NS | NS | NS | NS | NS | NS | NS |
| S X F X B | NS | NS | NS | NS | NS | NS | NS |
| C.V. % | 1.66 | 8.06 | 5.29 | 4.15 | 3.63 | 7.33 | 9.24 |

**Table 2: Test weight, yield and economics of *rabi* dhaincha as influenced by various treatments**

| Treatment | Test Weight (g) | Seed Yield (kg/ha) | Straw Yield (kg/ha) | Gross Realization (₹./ha) | Cost of Cultivation (₹./ha) | Net Realization (₹./ha) | BCR |
|---|---|---|---|---|---|---|---|
| **Spacing (S)** | | | | | | | |
| $S_1$ = 45cm | 20.66 | 1403 | 8053 | 96459 | 16648 | 79811 | 4.7 |
| $S_2$ = 60cm | 22.16 | 1533 | 8383 | 105017 | 16333 | 88684 | 5.4 |
| S. Em. ± | 0.49 | 21.15 | 115.25 | - | - | - | - |
| C.D. (P=0.05) | NS | 128.69 | 204.24 | - | - | - | - |
| C.V. % | 11.26 | 7.06 | 6.37 | - | - | - | - |
| **Inorganic Fertilizer (F)** | | | | | | | |
| $F_1$ = 75 % RDF | 20.83 | 1416 | 8335 | 97558 | 17540 | 80018 | 4.5 |
| $F_2$ = 100 % RDF | 22.00 | 1520 | 8665 | 104483 | 17838 | 86645 | 4.8 |
| S. Em. ± | 0.26 | 22.71 | 119.12 | - | - | - | - |
| C.D. (P=0.05) | 1.03 | 89.20 | NS | - | - | - | - |
| C.V. % | 6.03 | 7.58 | 7.20 | - | - | - | - |
| **Biofertilizer (B)** | | | | | | | |
| $B_0$ = No Bio fertilizer | 19.58 | 1236 | 8100 | 86024 | 16648 | 69376 | 4.1 |
| $B_1$ = *Rhizobium* | 20.50 | 1361 | 8460 | 94223 | 16698 | 77525 | 4.6 |
| $B_2$ = PSB | 23.25 | 1546 | 8794 | 106241 | 16698 | 89543 | 5.3 |
| $B_3$ = *Rhizobium* + PSB | 23.66 | 1729 | 9071 | 118018 | 16748 | 101270 | 6.0 |
| S. Em. ± | 0.34 | 30.33 | 124.70 | - | - | - | - |
| C.D. (P=0.05) | 1.01 | 88.54 | 220.95 | - | - | - | - |
| **Interaction** | | | | | | | |
| S X F | NS | NS | NS | - | - | - | - |
| S X B | NS | NS | NS | - | - | - | - |
| F X B | NS | NS | NS | - | - | - | - |
| S X F X B | NS | NS | NS | - | - | - | - |
| C.V. % | 5.65 | 7.16 | 5.32 | - | - | - | - |

***Selling price of Dhaincha: Seed – ₹. 63/kg Straw – ₹. 1.0/kg***

***[MS received: March 09, 2013 ]*** ***[MS accepted: April 11,2013]***