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RESEARCH ARTICLE

EFFECT OF ORGANIC MANURE IN SEED YIELD AND SEED ATTRIBUTES OF RAJMASH (P*HASEOLUS VULGARIS* L.) UNDER *VERTISOLS* OF CHHATTISGARH PLAINS, INDIA

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ABSTRACT

Rajmash (P*haseolus vulgaris* L.) commonly known as frenchbean is mainly the crop of hilly region and grown in northern states of India, its introduction to plain will improvised the socioeconomic condition of the farmers, as it is rich source of protein, calcium and phosphorous, also this crop has good commercial and as well as export value. In the present study Rajmash variety 'HUR-137' was sown at seed rate of 120 kg ha^{-1} for two consecutive year in *rabi* season under the treatment dose of 0 and 5 t ha^{-1} Farm yard manure (FYM) to evaluate its effect on seed yield and seed attributes by following randomized block design (factorial) and replicated thrice. 5 t FYM ha^{-1} shown significant increase in seed yield 1067 kg ha^{-1} as compared to 834 kg ha^{-1} along with increased number of pods $plant^{-1}$, number of seeds plant,$^{-1}$ number of seeds pod^{-1} , pod weight $plant^{-1}$, seed weight $plant^{-1}$, 100-seed weight (g), seed setting index, stover yield (kg ha^{-1}) against the 0 t FYM ha^{-1}. The productivity rating index of 5t FYM ha^{-1} remained statistically superior to 0 t FYM ha.$^{-1}$

INTRODUCTION

Globalization and industrialization brought easy availability of chemical fertilizers to the farmers. Unrestricted mammoth uses of chemical fertilizers increasing the cost of production and also damaging the soil fertility, mineral component and in long term to our ecosystem (Bhatiya and Shukla, 1982). World is looking towards an alternative which can help in maintaining the soil fertility without dropping productive potential. Organic manures like Farm Yard Manure (FYM) and compost have been traditionally important inputs for maintaining soil fertility and ensuring yield stability (Yadav *et al.,* 2013, Kundu *et al.,* 1996). FYM not only provides essential plant nutrients but also leads to buildup organic carbon and improve the soil physical condition as well as the soil biotic life and crop yield (Purushottam and Puri, 2002). In Chhattisgarh, rice being the main crop is grown in more than 80 per cent area of cropped area. Fields remain fallow after harvest of rice. Attempts are made to introduce more remunerative crops in rice based cropping system, among them, inclusion of protein rich crop of rajmash (*Phaseolus vulgaris* L.) in *rabi* season after the harvest of rice will not only provide higher return but also fulfill the demand of pulses in the state (Kumar *et al.,* 2004; Pandey *et al.,* 2004; Singh and Prasad, 1992). Rajmash being poor in nodulation, its nitrogen requirement is more than other pulses, farm yard manure can provide the nutrient requirement as well as play role in enhancing the production potential of *Phaseolus vulgaris* (Sharma and Verma 2011; Singh and Chauhan, 2009) . Hence in present study, Farm yard manure has been evaluated to study its effect on seed yield and other seed attributes affecting the production potential of rajmash under vertisol of Chattisgarh.

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MATERIALS AND METHODS

Experimental site and climate - The field experiments were carried out during winter (*rabi* season*)* at Research Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh for two consecutive years. This site comes under the 7th agro-climatic zone, sub humid with hot summer and cold winter. During study period, rainfall was 135.4, 2.3 mm, relative humidity varied between 24 to 96 % and 19 to 92 % in first year and second year of experiment respectively. Maximum temperature ranged from 25.8 to 35.9^{0}C and 26.0 to 33.5^{0}C, open pan evaporation was 2.8 to 4.2 mm day^{-1} and 2.8 to 4.8 mm day^1 during first and second year of experiment respectively. The soil of the experimental field was clayey in nature (*Vertisols*) locally known as '*Kanhar'* soil, neutral in reaction with low nitrogen, medium phosphorus and high potassium content.

Treatment details - Test crop rajmash (frenchbean)- *Phaseolus vulgaris* L. cultivar 'HUR-137' was sown at seed rate of 120 kg ha^{-1}. Seeds were treated with Bavistin @ 2.5 g, *Rhizobium* and PSB culture @10 g kg^{-1} seed before sowing and the spacing for the crop was 30 cm x 10 cm between and within the rows. The treatment of soil was consisted of FYM at level of 0 and 5 t ha^{-1} (the dose was selected based on the pilot studies).The experiment was laid out in a randomized block design (factorial) and replicated thrice. Four irrigations i.e. just after sowing, 30, 60 and 90 days were applied through sprinkler system. Pre-emergence application of Pendimethalin @ 1.0 kg ha^{-1} followed by 1 hand weeding at 30 days was quite effective in controlling weeds in rajmash.

Harvesting and Threshing - A net area of 15.96 m^2 was harvested on 109 to 112 days of crop with the help of sickles by manual labors. Harvesting of pods were done when the pod became yellowish brown and leaves turned reddish brown and started shedding. Four days after the harvesting and sun drying, the produce from individual net plot was tied into bundles, weighed and threshed manually and seed yield was recorded.

Post-harvest studies

The qualities of the seed were assessed by Average number of pods plant^{-1}: Number of seeds pod^{-1}, Number of seeds plant^{-1}, Pod and seed weight plant,$^{-1}$ 100-seed weight (g) were calculated from the 5 plants.

Seed setting index - Seed setting index was worked out by the following formula

$$\text{Seed setting index (\%)} = \frac{\text{No. of pods plant}^{-1} \text{ x Av. No. of seed pod}^{-1}}{\text{No. of seeds plant}^{-1}} \text{ x } 100$$

Seed yield (kg ha^{-1}): The weight of clean seeds recorded from each net plot was converted in to kg ha^{-1} by multiplying with the conversion factor of 626. Seed weight of sample plants was also added with plot yield before converting in to yield ha^{-1}.

Stover yield (kg ha^{-1}): The stover yield of each net plot including the stover weight of five sample plants was also converted kg ha^{-1} by multiplying with the factor used as in the case of seed yield.

Productivity rating index (PRI) - The productivity of rajmash was determined in *Vertisols* by using the following formula:

$$\text{PRI (\%)} = \frac{\text{Average seed yield (kg ha}^{-1}\text{) obtained in plots}}{\text{Standard yield of rajmash (kg ha}^{-1}\text{)}} \text{ x } 100$$

Standard yield of variety HUR 137 in Raipur condition was used as 12 q ha^{-1} (Pandey *et al.,* 2004).

Statistical analysis

Data collected through various observations on rajmash were subjected to the "Analysis of variance" appropriate to the design (RBD factorial) as given by Gomez and Gomez (1984). Test of significance of the treatment differences was done on the basis of 'F' test. The significant differences between treatments were compared with the critical difference at 5 per cent level of probability.

RESULTS

Number of pods plant^{-1} - Application of 5 t FYM ha^{-1} produced significantly higher number of pods plant^{-1} as compared to 0 t FYM ha^{-1} during 2nd year of experiment and on mean basis.

Number of seeds plant^{-1} - Use of 5 t FYM ha^{-1} produced significantly higher number of seeds plant^{-1} than 0 t FYM ha^{-1} during both the years and on mean basis.

Number of seeds pod^{-1} - Increasing trend in number of seeds pod^{-1} was noticed due to increase in subsequent levels of FYM. The maximum number of seeds pod^{-1} was observed under highest level of FYM, during both the years and on mean basis. On the contrary, the lowest number of seeds pod^{-1} was observed under no application of FYM during both the years and on mean basis.

Pod weight plant^{-1} (g plant^{-1}) - Significantly maximum pod weight plant^{-1} was observed under 5 t FYM ha^{-1} during first year of experiment and on mean basis.

Seed weight plant^{-1} (g plant^{-1}) - Increasing trend in seed weight plant^{-1} was observed @ 5 t FYM ha^{-1} it recorded the maximum seed weight plant^{-1} during both the years and on mean basis.

100-seed weight (g) - Between the FYM levels, significantly higher 100-seed weight was recorded under 5 t FYM ha^{-1} than 0 t FYM ha^{-1} during both the years, however, on the basis of mean, the differences between the FYM levels for 100-seed weight were non-significant.

Seed setting index (%) - Application of 5 t FYM ha^{-1} recorded significantly higher seed setting index as compared to 0 t FYM ha^{-1} during first year and on mean basis.

Seed yield (kg ha^{-1}) - Application of 5 t FYM ha^{-1} gave significantly higher seed yield (895 kg ha^{-1} and 1240 kg ha^{-1} in first and second year respectively, 1068 kg ha^{-1} on mean basis) as compared to 0 t FYM ha^{-1} (731 kg ha^{-1}, 942 kg ha^{-1} in first and second year respectively, 837 kg ha^{-1} on mean basis).

Stover yield (kg ha^{-1}) - The stover yield of rajmash was significantly higher under 5 t FYM ha^{-1} than 0 t FYM ha^{-1} during both the years and on mean basis.

Productivity rating index (PRI) - The grain yield performance of the treatments in relation to the average performance of the variety in the state (productivity rating index) revealed significant variations due to FYM. The productivity rating index of 5 t FYM ha^{-1} remained statistically superior to 0 t FYM ha^{-1} during both the years as well as in mean data.

Table: Effect of Organic manure (FYM) on seed yield and seed attributes of Rajmash (P*haseolus vulgaris* L.) under *vertisols* of chhattisgarh plains

Treatments	FYM (t ha^{-1})								
Parameters	F_0-0 First year	F_0-5 First year	SEm+/ CD(p=0.05)	F_0-0 Second year	F_0-5 Second year	SEm+/ CD(p=0.05)	F_0-0 Mean	F_0-5 Mean	SEm+/ CD(p=0.05)
Number of pods plant^{-1}	10.18	10.96	0.33/ NS	10.66	11.39	0.19/ 0.56	10.45	11.23	0.18/0.54
Number of seeds plant^{-1}	48.33	53.11	1.09/ 3.16	49.33	55.55	1.32/ 3.88	48.83	56.33	1.38/ 4.04
Number of seeds pod^{-1}	4.84	4.92	1.41/ NS	4.64	4.75	0.07/ NS	4.74	4.83	0.04/ NS
Pod weight plant^{-1} (g plant^{-1})	1.93	2.06	0.02/ 0.07	2.02	2.10	0.03/ NS	1.97	2.08	0.02/ 0.06
Seed weight plant^{-1} (g plant^{-1})	4.84	6.92	1.41/NS	4.64	4.75	0.07/NS	4.74	4.83	0.04/NS
100-seed weight (g)	40.28	43.38	0.36/ 1.06	41.72	42.93	0.30/ 0.90	41.00	43.15	1.67 /NS
Seed setting index (%)	70.60	73.74	0.94/ 2.77	73.93	75.24	0.46/NS	72.26	74.49	0.49/1.45
Seed yield (kg ha^{-1})	731	895	18.77/55.06	942	1240	16.44 /48.23	837	1068	12.43 /36.47
Stover yield (kg ha^{-1}) -	847	1018	25.74/ 75.51	1048	1367	46.21/ 135.55	948	1192	18.70.54.87
Productivity rating index (PRI)	60.91	74.56	3.82/ 11.56	78.43	103.63	7.40/ 22.4.	69.67	89.10	5.42/ 16.46

DISCUSSION

Rajmash (*Phaseolus vulgarius* L.) is one of the important pulse crops grown extremely under to high hills and good dry temperate condition of Himachal Pradesh. The introduction of rajmash in the plains of northern and central India as a *rabi* crop is one of the commendable contribution of the pulse scientists in the recent years. Frenchbean has now been proved a potential winter pulse crop (Ali and Kushwaha, 1987). The crop is highly sensitive to temperature and other climatic variation. Frenchbean is a slow growing crop and takes long time for the crop to cover the ground. Frenchbean is traditionally a rainy season (*kharif*) crop in the likely tracts of the country. It is more suitable as a winter (*rabi*) crop in the north eastern plains of India (Anonymous, 2000-01). Ali and Shankar (1991) also reported the specific adaptation of frenchbean to a cool and long growing season. Pandey *et al.*, (2004) also observed a sharp decrease in the yield of rajmash with delayed sowing because of reduced the number of pods plant^{-1}.

The seed is the resultant of growth and yield attributing characters of rajmash. The seed yield of rajmash was significantly higher under 5 t FYM ha^{-1} as compared to 0 t FYM ha^{-1} during both the years as well as on mean basis. The yield attributes such as number of pods plant^{-1}, number of seeds plant^{-1}, number of seeds pod^{-1}, seed weight, pod weight and 100-seed weight were maximum under 5 t FYM ha^{-1} and minimum under no FYM. The superiority of growth characters viz., plant height, branches, LAI; dry matter accumulation would have also be the possible reasons for the production of higher yield under 5 t FYM ha^{-1} as observed in the experiment (data not shown here). FYM is a decompose mixture of dung and urine of farm animal along with lifter and left over material from roughages or fodder fed to the cattle. It contains 0.5% N, 0.2% P_2O_5 and 0.5% K_2O. It supply plant nutrients including micronutrients, improve soil physical properties like structure, aeration, water holding capacity, provide food for soil microorganism and prevent loss of nutrients by leaching or erosion. Application of FYM @ 5 t ha^{1} significantly increased the plant height, number of leaves plant^{-1}, number of pods plant^{-1}, test weight and finally yield and also increased nodulation in soybean along with increased the availability of phosphorus and potassium in soil (Kumar and Singh, 1996, Jain *et al.,* 1995).

FYM play a direct role in supplying macro and micro-nutrients and an indirect one by improving the physical, chemical and biological properties of the soils. FYM contains almost all essential nutrient element and enhances nodulation, root growth and finally yield of most of the pulses. The beneficial effect of FYM has been reflected in seed and stover yield of rajmash. These results also supported by the findings of Roy *et al.* (2010), Singh and Chauhan (2009), Kumar and Puri (2002), reported that FYM had a significant effect on the growth, yield attributes, seed and straw yields of frenchbean. Application of 10 t FYM ha^{-1} recorded 25.9 and 19.6% more seed and straw yields, respectively, over no FYM application. The increase in yields due to FYM application is due to its favourable effect on nodulation, growth and yield attributes of the plant (Otieno *et al.,* 2009). Singh and Verma (2002) observed maximum plant height, branches plant^{-1}, pods plant^{-1} and 100-seed weight under 10 t FYM ha^{-1}. This increase in yield attributing characters was owing to improvement in physico-chemical properties of the soil and more availability of essential nutrients to plants, which supported the vegetative growth (plant height and branches plant^{-1}) and finally increased the pods plant^{-1} as well as the 100-seed weight. The possible reason for superiority of FYM may be owing to its rich nutritional composition, which increased the vegetative, yield attributing characters and finally the yield.

The stover yield of rajmash was significantly higher under 5 t FYM ha^{-1} than 0 t FYM ha^{-1} during both the years and on mean basis. This indicates that application of FYM minimize the unproductive competition between vegetative and reproductive growth, ultimately leading to economic yield improvement. Significant impact of 5 t FYM ha^{-1} in case of rajmash productivity was noted in different locations like Varanasi, Durgapura and Raipur (Anonymous, 2002-03). In Chhattisgrh, during *rabi* season pulses are mostly grown as relay crop specially in mid and low land rice. In some areas, it is also grown after field preparation by utilizing residual moisture or with partial irrigation facilities. Now there is need to shift in cropping plan and management of legumes to make this farming more profitable. The farmers perceptions about pulses that these crops are component of subsistence farming need to be changed. However, in certain pockets of state where assured irrigation is available inclusion of high value crop like frenchbean or rajmash will definitely uplift the socio-economic conditions of poor farming community of Chhattisgarh state.

Application of organic manure like FYM is proved its role in enhancing the production of rajmash (P*haseolus vulgaris* L.) in *vertisols* of chhattisgarh plains which also maintain the physiochemical property of soil. In long term this will definitely have impact on the soil quality, reduction of cost of production, economic growth of farmer, availability of nutritive food and maintenance of our ecology system.

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