

Effect of Different Methods of Fertilizer Application and Varying Tillage Conditions on Nutrient Content, Uptake, Quality and Soil Fertility of Horse Gram

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Abstract An experiment was conducted during *rabi* season of 2012-2013 to study the effect of different methods of fertilizer application and varying tillage conditions on nutrient content, uptake quality and soil fertility of horse gram. The field experiment was laid out in a split plot design with three replications. The main plot treatment comprised four tillage conditions viz. minimum tillage (drilling), conventional tillage with drilling, conventional tillage with dibbling and zero tillage (dibbling) and sub plot treatments comprised four methods of fertilizer application absolute control, 100% RDF (soil application), 25% RDF (foliar application) and 50% RDF (foliar application). The result revealed that tillage treatments conventional tillage with dibbling and conventional tillage with drilling was found significantly superior over rest of the treatments but at par with each other and recorded higher N and P content uptake, Protein percentage in grain and straw. The available N and P_2O_5 content of soil after harvest of horse gram due to different tillage conditions were not influenced significantly. Among the methods of fertilizer application viz. 100% RDF (soil application) and 50% RDF (foliar application) were found significantly superior

over remaining treatments but statistically identical with each other in respect of higher N and P content, uptake, protein percentage in grain and straw and available N, P content in soil after harvest. Horse gram crop should be grown in conventional tillage condition by dibbling method along with soil application of 100% recommended dose of fertilizer at sowing time, to obtain higher nutrient content, uptake and better quality.

Keywords Horse gram, Tillage condition, Methods of fertilizer, Quality, Uptake.

Introduction

India has a distinction of being world's largest producer and consumer of pulses. Over a dozen of pulse crops like pigeon pea, chick pea, green gram, black gram, lentil, pea, moth bean, cowpea, field bean and horse gram are grown in India. In India the total production of pulses was 18.09 million tonnes from an area of 26.28 million hectares with average productivity of 689 kg ha⁻¹ [1]. The total production of pulses in Maharashtra was 23,104 tonnes from an area of 32,967 hectares with average productivity of 701 kg ha⁻¹. In konkan region total pulses production was 307 tonnes from an area of 482 hectares with average productivity 636 kg ha⁻¹ [2].

Botanically horse gram is *Dolichus biflorus* Roxb belonging to family Leguminosae. India is the major

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country in the world growing horse gram. It is drought tolerant, hardy and generally grown as sole crop in less fertile soils. It is grown largely in Southern Indian area having the acute rainfall not more than 750 mm. Konkan region of Maharashtra, horse gram is mainly grown in *rabi* season in rice field after harvest of *kharif* rice both on residual moisture as well as under irrigation. Horse gram is one of under - exploited grain legumes with great potential in sustainable agriculture. Hence, there is scope to enhance the productivity of horse gram by proper agronomic practices such as tillage and fertilizer management.

Tillage was considered as an 'art' and in the recent years, research evidence has focused tillage as 'science'. There are various systems of tillage, such as minimum tillage, zero tillage, conventional tillage. From time immemorial various methods of ploughing have been tried by trial and error, based on the labor availability and economic status of the farmer.

Fertilizers are applied by different methods to make the nutrient easily available to crops, to reduce the fertilizer losses and for easy application. Basal dose of fertilizer application has a significance importance in the vegetative growth and in maintain yield characteristics. Foliar application of nutrients for increasing and exploiting genetic potential of the crop is considered as an efficient and economic method of supplementing the nutrient requirement and enhancing the nutrient availability.

Materials and Methods

Field experiment was conducted on plot No 69 of 'C' block of Agronomy Department Farm, College of Agriculture, Dapoli Dist Ratnagiri during *rabi* season of 2012-2013. The field experiment was laid out in a split plot design. The main plot treatments comprised four tillage conditions minimum tillage with drilling (S_1), conventional tillage with drilling (S_2), conventional tillage with dibbling (S_3) and zero tillage (dibbling) (S_4) and sub plot treatments comprised four methods of fertilizer application absolute control (F_1), 100% RDF (soil application) (F_2), 25% RDF (foliar application) (F_3) and 50% RDF (foliar application) (F_4). Thus, there were in all sixteen treatment combinations replicated three times. The gross plot size was 4.0 m $\times$ 3.0

m and net plot size was 3.6 m $\times$ 2.4 m respectively. The soil of the experimental plot was sandy clay loam in texture, medium in available nitrogen (294.20 kg ha⁻¹), low in phosphorus (13.20 kg ha⁻¹), medium in available potassium (164.60 kg ha⁻¹), medium in organic carbon (0.96%) and slightly acidic in reaction.

Field for the experimental crop was prepared as per the tillage system treatments. The preparatory tillage operation carried out as per the main treatments. Sowing of horse gram was done on 5th December, 2012 by using the seed rate of 20 kg ha⁻¹ of horse gram. The sowing of treated seeds was done as per treatments. The quantity of fertilizer dose for each plot was calculated and applied through soil and foliar application as per the treatments. The quality of 100% RDF (25:50:00 NPK kg ha⁻¹) was applied to sub plots as per treatment as soil application by placement methods. Full dose of nitrogen and phosphorus were applied in the form of urea (46.% N) and single super phosphate (16% P₂O₅) respectively, as basal dose. Foliar applications of fertilizers were started from 24 days after sowing. Fertilizer used for foliar application was urea and DAP @ 36 g DAP + 4.2 g urea, which was dissolved in 7.2 liter water and applied for treatment of 25% RDF through foliar spray and doubled the quantity of fertilizers and water to the treatment 50% RDF through foliar spray used for each spray. Total eleven sprays were applied at the interval of four days during the experimentation. Other common package of practices was followed time to time. Crop was harvested at physiological maturity and data on yield attributes and yield were recorded. The soil samples collected after harvest of horse gram crop were used for determination of available nitrogen, phosphorus (kg ha⁻¹) by Alkaline KMnO₄ method and Bray's No 1 method. Nitrogen and phosphorus content in grain and straw determined by Modified micro-kjedahl's and Spectro- photometer method respectively. The uptake of nitrogen, phosphorus (kg ha⁻¹) by horse gram crop were calculated by multiplying percent nitrogen, phosphorus content in grain and straw with corresponding grain and straw yields of each treatment and then dividing with 100. Treatment wise total uptake was computed by summing up ha⁻¹ uptake by grain and straw. Protein percentage calculated by nitrogen percentage multiplied by 6.25.

Table 1. Effect of tillage conditions and methods of fertilizer application N and P content, uptake of horse gram.

Treatments	N content (%)		P content (%)		N uptake (%)		P uptake (%)		Total N uptake	Total P uptake
	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw		
Tillage conditions										
S ₁ –Minimum tillage	3.45	1.15	0.266	0.074	24.41	17.97	2.01	1.17	42.38	3.06
S ₂ –Conv with drilling	3.53	1.25	0.278	0.083	32.28	23.78	2.51	1.58	56.06	4.14
S ₃ –Conv with dribbling	3.57	1.29	0.280	0.084	34.77	26.00	2.74	1.70	60.78	4.45
S ₄ –Zero tillage	3.37	1.06	0.250	0.062	19.07	13.71	1.39	0.80	32.78	2.21
<i>F</i> test	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
SEM±	0.01	0.002	0.002	0.001	1.09	0.72	0.10	0.04	1.44	0.13
CD at 5%	0.004	0.007	0.006	0.004	3.76	2.19	0.34	0.13	4.99	0.45
Methods of fertilizer application										
F ₁ –Control	3.45	1.07	0.252	0.064	17.56	12.74	1.37	0.77	30.31	2.08
F ₂ –100% RDF (Soil)	3.53	1.28	0.283	0.085	35.78	26.23	2.84	1.73	62.02	4.60
F ₃ –25% RDF (Foliar)	3.57	1.15	0.261	0.074	25.76	18.11	1.89	1.16	43.87	3.06
F ₄ –50% RDF (Foliar)	3.37	1.25	0.278	0.081	31.43	24.38	2.56	1.59	55.80	4.12
<i>F</i> test	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
SEM±	0.002	0.002	0.002	0.002	1.62	1.14	0.12	0.06	2.59	0.18
CD at 5%	0.006	0.06	0.005	0.005	4.74	3.52	0.35	0.17	7.56	0.52
Interaction effect										
<i>F</i> test	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
SEM±	0.04	0.04	0.0035	0.003	3.62	0.04	0.24	0.118	5.70	0.36
CD at 5%	–	–	–	–	–	–	–	–	–	–
General mean	3.49	1.19	0.268	0.075	27.63	1.19	2.16	1.31	48.00	3.46

Results and Discussion

Effect of tillage conditions on N and P content and uptake of horse gram

Table 1 reveals that, the nitrogen and phosphorus content, uptake in grain, straw and its total uptake by horse gram crop was significantly influenced by various tillage conditions. Among different tillage conditions, nitrogen and phosphorus content, uptake in grain, straw and its total uptake by horse gram crop was significantly higher under treatments S₃ followed by treatment S₂ which was at par with each other and significantly superior than rest of the treatments viz. S₁ and S₄. Treatment S₁ was found significantly superior to treatment S₄. Treatment S₄ i.e. zero tillage recorded significantly lower nitrogen content, uptake in grain, straw and its total uptake by horse gram crop. This might be due to the fact that the crop ab-

sorbed proportionately higher amount of N and P due to their higher availability in soil pool under comparatively better physical status of soil in rhizosphere provided by conventional and minimum tillage systems that promoted the profused root and shoot growth which increased the above ground growth of crop. The results resemble the findings of Chendge [3].

Effect of methods fertilizer on N and P content and uptake of horse gram

Table 1 reveals that, the nitrogen and phosphorus content, uptake in grain, straw and its total uptake by horse gram crop was significantly influenced by various methods of fertilizer application. Treatment 100% RDF (soil application) significantly increased nitrogen and phosphorus content, uptake in grain, straw and its total uptake followed by 50% RDF (foliar ap-

Table 2. Protein content and available N and P content in soils as influenced by different treatments.

Treatments	Protein content (%) Grain	Protein content (%) Straw	Available N (kg ha ⁻¹)	Available P (kg ha ⁻¹)
Tillage conditions				
S ₁ -Minimum tillage	21.56	7.19	301.67	13.57
S ₂ -Conv with drilling	22.06	7.81	297.00	13.20
S ₃ -Conv with dibbling	22.29	8.05	296.25	13.07
S ₄ -Zero tillage	21.07	6.63	304.00	14.08
F test	Sig	Sig	NS	NS
SEm±	0.08	0.13	2.04	0.23
CD at 5%	0.28	0.45	—	—
Methods of fertilizer application				
F ₁ -Control	21.14	6.67	299.58	13.09
F ₂ -100% RDF (Soil)	22.14	8.02	306.00	14.73
F ₃ -RDF (Foliar)	21.67	7.16	297.67	13.08
F ₄ -50% RDF (Foliar)	22.04	7.83	295.67	13.00
F test	Sig	Sig	Sig	Sig
SEm ±	0.11	0.13	2.00	0.27
CD at 5%	0.33	0.39	5.84	0.77
Interaction effect				
F test	NS	NS	NS	NS
SEm±	0.23	0.27	4.00	0.53
CD at 5%	—	—	—	—
General mean	21.75	7.42	299.73	13.48

plication) which was at par to each other but both treatment found significantly superior over remained treatments i.e. F₃ and F₁. Treatment F₃ i.e. 25% RDF (foliar application) also recorded significantly higher nitrogen and phosphorus content, uptake in grain, straw and its total uptake by horse gram crop over no fertilizer application (F₁). Since uptake is a function of grain and straw yield and their nutrient content, the significant improvement in content of these nutrients coupled with increased grain and straw yield increased the uptake of nutrients substantially. The above observations are in accordance with Shukala et al. [4].

Effect of tillage conditions on protein content and available N and P status of horse gram

Table 2 reveals that various tillage treatments significantly influenced the protein content in grain of horse gram. The tillage treatment S₃ recorded higher protein content (22.29%) followed by treatment S₂ which was at par with each other and statically sig-

nificant over treatments S₁ and S₄. Similarly, treatment S₁ was found significantly superior to treatment S₄. Protein content is function of nitrogen accumulation, higher nitrogen content above treatments resulting higher protein content. The results close to confirmed findings of Chendge [3].

The available N and P₂O₅ content of soil after harvest of horse gram due to different tillage conditions were not influenced significantly but higher value of available N and P₂O₅ found in zero tillage this observation accordance with Reddy et al. [5].

Effect of methods of fertilizer application on protein content and available N and P status of horse gram

The results revealed (Table 2) that, application of different methods of fertilizer application significantly influenced the protein content of grain and straw. Treatment F₁ recorded significantly lower protein in grain (21.14%) and straw (6.67) over rest of the treat-

ments. Significantly higher protein content in grain and straw was recorded in treatment F_2 followed by treatment F_4 which remained statistically identical with each other and significantly superior over treatment F_3 and F_1 . Treatment F_3 also content significantly higher protein content over treatment F_1 i.e. control. This was due to higher nitrogen content and uptake in treatment F_2 than rest of the treatments. Nitrogen is major constituents of protein and therefore, higher accumulation of nitrogen in grain and straw under treatment F_2 resulted into more synthesis of protein in it.

Availability of nitrogen and phosphorus in the soil after harvest of horse gram was significantly influenced by different methods of fertilizer application. Available nitrogen (306) and phosphorus (14.73) kg ha⁻¹, was significantly more in soil under the treatment F_2 over the treatments F_1 , F_3 and F_4 . The treatments F_1 , F_3 and F_4 remained statistical identical with each other. Soil application significantly increased the available nutrients content in soil after harvest of crop over foliar application reported by Vijay Kumar [6].

Conclusion

Form the results of the present investigation it can be concluded that, horse gram crop should be grown in

conventional tillage condition by dibbling method along with soil application of 100% recommended dose of fertilizer at sowing time, to obtain higher nutrient content, uptake and better quality. If it is not possible to apply 100% RDF through soil, then 50% RDF through foliar spray can be applied.

The experimental result is based on only one year study. Therefore, need confirmation by repeating the investigation.

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