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Effect of Different Methods of Fertilizer Application and Varying Tillage Conditions on Growth and Yield of Horse Gram

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An experiment was conducted at agronomy farm of Dr. B.S.K.K.V., Dapoli during *rabi* season of 2012-2013 to study the effect of different methods of fertilizer application and varying tillage conditions on growth and yield of horse gram. The field experiment was laid out in a split plot design. The main plot treatments 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 viz. absolute control, 100% RDF (soil application), 25% RDF (foliar application) and 50% RDF (foliar application). Thus, there were in all sixteen treatment combinations replicated three times. The soil of the experimental plot was sandy clay loam in texture, medium in available nitrogen, low in phosphorus, medium in available potassium, medium in organic carbon and slightly acidic in reaction. The result revealed that tillage treatments involving 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 growth parameters, yield attributes, grain and straw yield. Among the methods of fertilizer application *viz*. 100% RDF (soil application) and 50% RDF (foliar application) significantly influenced growth parameters, yield attributes, grain and straw yields. These methods were found significantly superior over remaining treatments but statistically identical with each other.

(***Key words:*** *Fertilizer, Growth, Horse gram, Tillage, Yield*)

Botanically horse gram is *Dolichus biflorus* Roxb belonging to family *leguminoceae*, having chromosome no. 2n = 24. It is quite probable to have originated in South-East Asia, more so in peninsular India where it forms an important pulse crop. India is the major country in the world growing horse gram. It is grown largely in Southern India, where the annual rainfall is not more than 750 mm. This crop is drought tolerant, hardy and generally grown as sole crop in less fertile soils. In *Konkan* region of Maharashtra, horse gram is mainly grown during *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.

The mechanical manipulation of the soil for loosening the surface crust aimed at bringing the conditions favourable for germination of seeds or planting of seedlings and the growth of crops is called as tillage, while the physical conditions brought about by tillage operations is called as tilth. 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, etc. From time immemorial various methods of ploughing have been tried by trial and error, based on the labour availability and economic status of the farmer.

Fertilizers are applied by different methods mainly soil application and foliar application. 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. Application of fertilizer to foliage of the crop as spray solution is known as foliar spray of fertilizer. 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.

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MATERIALS AND METHODS

A field experiment was conducted on plot No. 69 of 'C' block of Agronomy Department Farm, College of Agriculture, Dapoli. during *Rabi* season 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 x 3.0 m and net plot size was 3.6 m x 2.4 m, respectively. The soil of the experimental plot was sandy clay loam in texture, medium in available nitrogen, low in phosphorus, medium in available potassium, medium in organic carbon and slightly acidic in reaction.

Field for the experimental crop was prepared as per the tillage system treatments. The preparatory tillage operations 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.

100% RDF (25-50-00 kg N-P-K ha^{-1}) was applied through soil as basal dose for treatment F_2. Foliar applications of fertilizers were started from 24 days after sowing. Total eleven spays were applied at the interval of four days during the experimentation. The 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.

RESULTS AND DISCUSSIONS

Effect of tillage conditions on growth parameters of horse gram

It is evident from the data presented in (Table 1) that a marked effect of tillage conditions was observed on growth characters of horse gram. Treatment S_3 (conventional tillage with dibbling) and S_2 (conventional tillage with drilling) significantly increased the growth parameters of horse gram such as, plant height (cm), number of functional leaves per plant, number of branches per plant and dry matter accumulation per plant (gm.) as compared to S_1 (minimum tillage with drilling) and S_4 (zero tillage with dibbling). Treatment S_1 was found to be significantly superior over treatment S_4 *i.e.* zero tillage. While, in case of plant height treatment S_2 found to be significantly superior over remaining treatments except treatment S_3 which was statistically similar with former treatment S_2. Further, treatment S_4

Table 1. *Effect of tillage conditions and methods of fertilizer on growth of horse gram*

Treatments	Plant height (cm)	Number of leaves $plant^{-1}$	Number of branches $plant^{-1}$	Dry matter accumulation $plant^{-1}$ (g)
Tillage conditions				
S_1- Minimum tillage	32.88	8.45	5.54	5.70
S_2- Conv. with drilling	36.65	9.73	6.67	6.40
S_3- Conv. with dibbling	35.44	10.53	6.87	6.80
S_4- Zero tillage	29.07	5.94	4.41	4.99
S.Em. ±	0.81	0.30	0.23	0.201
C.D. at 5%	2.79	1.04	0.79	0.695
Methods of fertilizer application				
F_1- Control	28.32	6.00	5.00	5.21
F_2- 100% RDF (Soil)	36.84	10.48	6.43	6.48
F_3- 25% RDF(Foliar)	33.18	7.78	5.78	5.83
F_4- 50% RDF (Foliar)	35.70	10.39	6.29	6.38
S.Em. ±	0.81	0.48	0.16	0.174
C.D. at 5%	2.35	1.39	0.46	0.507
Interaction effect	NS	NS	NS	NS
General Mean	33.51	8.66	5.87	5.49

recorded significantly lowest values of growth and development parameters. The increase in values of growth parameters under above treatments were mainly attributed due to good tilth resulted from the tillage conditions. Similar findings were also reported by Osuji (1990) and Mahata *et al.* (1992).

Effect of methods of fertilizer application on growth parameters of horse gram

It could be seen from table 1 that the growth parameters *viz*., plant height, number of functional leaves plant, number of branches plant^{-1} and dry matter accumulation plant^{-1}, was the highest in treatment F_2 (100% RDF through soil application) followed by treatment F_4 (50% RDF through foliar application) which was at par with each other but found significantly superior over treatment F_3 (25% RDF through foliar application) and F_1 (control) in that descending order of significance. Significantly, the lowest values of plant growth parameter was observed in the treatment F_1 (control) over rest of the treatments. The increase in the growth parameters of horse gram under treatment F_2 was due to basal application of fertilizer through soil as compared with rest of the treatments.

After supplying higher dose of N and P_2O_5 as in case of F_2 and foliar application of 50 per cent RDF under treatment F_4 contributed probably higher chlorophyll content which enables the crops photosynthetically more active and therefore higher dry matter accumulation, which was reflected in recording of superior values of growth parameters such as plant height (cm), number of leaves plant^{-1}, number of branches plant^{-1} and dry matter accumulation (g) followed by treatments F_3 and F_1. Nutrients application through soil at the time of sowing had increased the growth attributes over foliar application and control due to availability nutrient through roots at early stages of growth. Similar findings were also reported by Upadhyay *et al*. (1988) and Veerbhadrappa and Yeledhalli (2005).

Effect of tillage conditions on yield attributes and yield of horse gram

It is seen from the data presented in Table 2 that, the treatment S_3 recorded maximum number of pods per plant (29.83), Number of grains per pod (3.75), number of grains per plants (111.3), weight of pods per plant (4.83 g) and test weight (27.74 g) followed by treatments S_2 which were at par with each other but found significantly superior over S_1 and S_4. Treatment S_1 (minimum tillage) significantly increased all yield attributes over S_4 (zero tillage). The possible reason of high yield attributing characters may be traced due to the increased dry matter production might have resulted in greater synthesis of photosynthates contributing to an increase in yield attributes.

Table 2. *Mean yield attributing characters, grain and straw yield of horse gram as influenced by different treatments*

Treatments	No. of pods plant^{-1}	No. of grains pod^{-1}	No. of grains plant^{-1}	Wt. of pods plant^{-1} (g)	100 grain weight (g)	Grain Yield (t ha^{-1})	Straw Yield (t ha^{-1})
Tillage conditions							
S_1- Minimum tillage	25.67	3.55	91.73	4.11	25.84	0.71	1.54
S_2-Conv. with drilling	28.08	3.68	105.59	4.60	27.13	0.91	1.86
S_3- Conv. with dibbling	29.83	3.75	111.13	4.83	27.74	0.97	2.00
S_4- Zero tillage	22.42	3.13	71.18	3.69	24.77	5.63	1.28
S.Em. ±	0.65	0.03	2.13	0.08	0.27	0.028	0.056
C.D. at 5%	1.94	0.10	7.36	0.29	0.93	0.096	0.074
Methods of fertilizer application							
F_1- Control	20.83	3.07	63.47	3.81	24.53	0.52	1.18
F_2-100% RDF (Soil)	31.00	3.81	118.25	4.6	27.90	1.00	2.00
F_3- 25% RDF(Foliar)	25.08	3.47	86.50	4.28	26.00	0.74	1.56
F_4-50% RDF (Foliar)	29.08	3.76	111.40	4.51	27.05	0.89	1.93
S.Em. ±	0.67	0.06	2.83	0.07	0.32	0.46	0.78
C.D. at 5%	1.97	0.18	8.25	0.21	0.94	0.133	0.229
Interaction effect	NS	NS	NS	NS	NS	NS	NS
General mean	26.50	3.53	94.90	4.31	26.37	0.78	1.67

Data furnished in Table 2 stipulated that the tillage treatment S_3 recorded higher grain yield (0.97 t ha^{-1}) and straw yield (2.0 t ha^{-1}) followed by treatment S_2 which was at par with each other and significantly superior over S_1 and S_4 in that descending order of significance. However, significantly the lowest grain yield was recorded in treatment S_4 *i.e.* zero tillage. The minimum tillage was also found to be significantly superior over zero tillage for grain and straw yield. The higher grain yields obtained from conventional and minimum tillage may be due to significant increase in yield attributes in these treatments. Similar results have been reported by Kadian *et al.* (2007).

Effect of methods of fertilizer application on yield attributes and yield of horse gram

The results revealed that, application of 100 % RDF (soil application) which was statistically at par with treatment F_4 (50% RDF foliar) and significantly improved the yield attributing characters over rest of treatments *i.e*. F_3 and F_1. Treatments F_3 was significantly superior over treatments F_1. Increased yield attributes were due to increasing growth character in above treatments. These results are in line with those reported by Upadhay *et al*. (1988)) and Raghuwansi *et al*. (1993).

It is revealed from the data presented in Table 2 that fertilizer application method F_2 recorded maximum grain yield (1.0 t ha^{-1}) and straw yield (2.0 t ha^{-1}) followed by treatment F_4 which was at par with each other and found significantly superior over treatments F_3 and F_1 in that descending order of significance. Treatment F_3 was significantly superior over treatment F_1 for grain yield and straw yield. The significantly lowest grain yield (0.52 t ha^{-1}) was recorded in treatment F_1 *i.e.* control. Increase in grain and straw yields was observed due to increasing level of fertilizer application either through soil or foliar application over control. Soil application increased grain and straw yield over foliar application as plants could not absorb all the nutrients which were supplied through foliar without any basal dose. These results are in line with those reported by Upadhay *et al.* (1988) and Muhammad Hamayun *et al.* (2011).

CONCLUSION

From 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 per cent recommended dose of fertilizer at sowing time, to obtain higher value of growth parameters and yields. If it is not possible to apply 100 % RDF through soil, then 50% RDF through foliar spray can be applied.

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