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Performance of *rabi* Horsegram as influenced by *kharif* Finger Millet Crop Geometry and Nutrient Management Practices

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ABSTRACT: Finger millet-horsegram crop sequence has the potential to provide secured income to the farmer, maintain the soil health besides sustain agricultural production. The productivity of succeeding crops depend on preceding crops and their level of management. The present investigation is designed to study the influence of crop geometry and nutrient management practices in kharif grown finger millet on rabi horsegram. A Field experiment was conducted at Agricultural college farm, Bapatla during the *kharif* and *rabi* seasons of 2018-19 and 2019-20 to study the residual effect of nutrient management approaches in finger millet on growth and yield of succeeding horsegram crop under finger millet - horsegram system. The experimental design was split plot with three replications. The main-plot factor comprised of three crop geometries with different age of seedlings (30x10 cm with 30 days old seedlings, 30×30 cm with 15 days old seedlings and 45 × 45 cm with 15 days old seedlings) and seven nutrient management practices (S_0: absolute control, S_1: FYM @ 10 tonnes ha^{-1} + application of *dravajeevamrutham*, S_2: FYM @ 10 tonnes ha^{-1} + application of *dravajeevamrutham* along with wooden log treatment, S_3: FYM @ 10 tonnes ha^{-1} + 100% RDF, S_4: FYM @ 10 tonnes ha^{-1} + 100% RDF along with wooden log treatment, S_5: FYM @ 10 tonnes ha^{-1} + 125% RDF, S_6: FYM @ 10 tonnes ha^{-1} + 125% RDF along with wooden log treatment in subplots were given to *kharif* finger millet. During succeeding *rabi* season on the same field horsegram was grown to study the residual impact. Days to first flowering, 50% flowering, days to maturity and yield attributes except pods plant^{-1} were not influenced significantly by residual effect of various crop geometries and nutrient management treatments given to the preceding finger millet crop and their interaction. The application of FYM @ 10 tonnes ha^{-1} + 125% RDF along with or without wooden log treatment to finger millet reported the significant residual effect on yield and pods plant^{-1} of succeeding horsegram crop.

Keywords: Finger millet-horsegram, cropping sequence, nutrient management, yield attributes and yield.

INTRODUCTION

The important tool to increase agricultural productivity is to increase cropping intensity through improved cropping systems. They make use of the potential cropping period and make efficient use of growth resources so that high and stable productivity could be achieved. Many cereal based intensive cropping systems are in vogue in different agroclimatic regions of the country. As growing of only cereals is not much remunerative in the present agricultural scenario to overcome the diverse demand of consumers and fast growing population. Planning intensive cultivation through the sequence cropping systems in a sustainable way will help in increasing the food grain production. Finger millet is a very compatible crop and can accommodate in any cropping system such as intercropping, sequential cropping, strip cropping, mixed cropping and crop rotation etc. (Meena *et al*., 2017). Crop rotation is an effective tool for sustainable

production with efficient utilization of crop input resources. Legumes with their ability to fix nitrogen very conveniently adapt to different cropping patterns and may offer opportunities to sustain increased productivity (Jeyabal and Kuppuswamy, 2001). Under such situations finger millet-legume rotation assume one of the important practices to achieve sustainability in crop production and thus finger millet-horsegram sequence can be one of the major finger millet based crop rotations for southern states of India. This crop sequence has the potential to provide secured income to the farmer, maintain the soil health besides sustain agricultural production. As the productivity of succeeding crops depend on preceding crops and their level of management, the residual effect of nutrients refers to the conservation over benefit of applied nutrients available to the succeeding crops. Greater proportion of residual fertilizer nitrogen was preserved in the upper 60 cm profile and a substantial amount of NO_3-N was found up to 180 cm of the soil profile (Subbaiah and Sachdev, 1983). Since many studies have revealed that only a fraction of applied phosphatic fertilizer is utilized by a single crop and considerable amount of nutrients are left over in soil (Goswami and Singh, 1976), it was felt appropriate to design an experiment to know the residual effect of nutrient management approaches in finger millet on performance of *rabi* horsegram under finger millet - horsegram cropping sequence.

MATERIALS AND METHODS

The experiment was conducted at Agricultural college farm, Bapatla during the *kharif* seasons of 2018 and 2019. The soil of experimental site was sandy clay loam in texture with slightly alkaline reaction, low organic carbon content, low available nitrogen and medium in available phosphorous and potassium. The experiment was laid in split plot design with 21 treatments, replicated thrice. The treatments comprised of two factors, *viz*., crop geometries with different age of seedlings (M_1: 30 × 10 cm with 30 days old seedlings, M_2: 30 × 30 cm with 15 days old seedlings and M_3: 45 × 45 cm with 15 days old seedlings) and seven nutrient management practices (S_0: absolute control, S_1: FYM @ 10 tonnes ha^{-1} + application of *dravajeevamrutham*, S_2: FYM @ 10 tonnes ha^{-1} + application of *dravajeevamrutham* along with wooden log treatment, S_3: FYM @ 10 tonnes ha^{-1} + 100% RDF, S_4: FYM @ 10 tonnes ha^{-1} + 100% RDF along with wooden log treatment, S_5: FYM @ 10 tonnes ha^{-1} + 125% RDF, S_6: FYM @ 10 tonnes ha^{-1} + 125% RDF along with wooden log treatment. Yield parameters like pods $plant^{-1}$, seeds pod^{-1} and test weight were recorded. Seed yield of horsegram was calculated to kg ha^{-1}. The data was statistically analyzed at 0.05 level of probability following the procedure outlined by Panse and Sukhatme (1978).

RESULTS

Number of days taken for first flowering, 50% flowering and days to maturity were not influenced by residual effect of various crop geometries and nutrient management treatments given to the preceding finger millet crop and their interaction.

Table 1: Days to first flowering, 50% flowering and days to maturity of *rabi* horsegram as influenced by *kharif* finger millet crop geometry and nutrient management practices during 2018-19 & 2019-20 and in pooled data.

Treatments	First flowering			50% flowering			Days to maturity		
	2018-19	2019-20	Pooled data	2018-19	2019-20	Pooled data	2018-19	2019-20	Pooled data
Crop geometry									
M_1- 30×10cm with 30 days old seedlings	36	36	36	46	47	47	89	88	89
M_2- 30×30cm with 15 days old seedlings	37	37	36	46	46	46	88	88	88
M_3- 45×45cm with 15 days old seedlings	37	37	37	46	47	47	88	87	87
S.Em±	0.98	1.05	0.87	1.35	1.14	1.01	2.10	1.95	2.53
CD (p = 0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS
CV (%)	12.28	13.24	10.99	13.33	11.16	9.91	10.89	10.16	13.16
Nutrient management									
S_0-Absolute control	37	37	37	47	47	47	89	88	89
S_1- FYM @ 10 tonnes ha^{-1} + *dravajeevamrutham*	37	37	37	47	47	47	89	88	88
S_2- S_1+ passing wooden log	37	37	37	47	46	47	89	88	88
S_3- FYM @ 10 tonnes ha^{-1} + 100% RDF	36	36	36	45	46	46	88	87	87
S_4- S_3+ passing wooden log	36	36	36	46	47	46	88	88	88
S_5- FYM @ 10 tonnes ha^{-1} + 125% RDF	36	36	36	46	47	47	88	88	88
S_6 - S_5+ passing wooden log	36	36	37	46	46	46	88	87	88
S.Em±	0.43	0.81	0.64	0.92	0.95	0.69	1.61	0.91	1.64
CD (p = 0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS
CV (%)	3.54	6.69	5.29	5.91	6.08	4.43	5.46	3.11	5.59
Interaction									
M × S	NS	NS	NS	NS	NS	NS	NS	NS	NS
S × M	NS	NS	NS	NS	NS	NS	NS	NS	NS

A glance at the data clarifies that the nutrient management practices imposed on finger millet alone had a significant impact while, the crop geometry of finger millet did not exert any significant influence on the number of pods plant^{-1} of horsegram. These findings corroborate with results obtained by Patel (1994). Interaction between crop geometry and nutrient management treatments was also non significant.

The data on number of pods plant^{-1} was significantly influenced by various nutrient management treatments imposed to preceding finger millet and the highest number of pods plant^{-1} (29.53, 30.23 and 29.88 during 2018-19, 2019-20 and in pooled data, respectively) were recorded with S_6, which was comparable with all the integrated nutrient management practices imposed to preceding finger millet. The lowest number of pods plant^{-1} (21.29, 22.33 and 21.81 during 2018-19, 2019-20 and in pooled data, respectively) were observed in the absolute control.

Nutrients applied to previous finger millet showed carry over effect on the following horsegram comparing with absolute control. The integrated use of organic manure with inorganic fertilizer had significant influence on number of pods plant^{-1}, compared to control. Such effect may be due to increased availability of nutrient in soil from native pool as well as their residual effect through mineralization and improvement of physico-chemical properties of soil and thereby improving water and nutrient holding capacity of soil. These results are in accordance with Gudadhe (2008) in cotton-chickpea and Saha (2010) in maize-mustard cropping sequence. Similar results were also reported by the earlier findings of Arif *et al*., (2011); Sohu *et al*., (2015).

Number of seeds pod^{-1} of horsegram was not influenced significantly by various crop geometries and nutrient management treatments given to preceding finger millet crop. Number of seeds per pod is more influenced by the genetic make up of the plant and agronomic management's role in influencing the number of seeds per pod was minimum. The residual impact of the nutrient management practices could not sustain to influence significantly the number of seeds per pod of horsegram. The number of seeds pod^{-1} did not reach the level of significance due to various treatments. Similar results were also reported by Koireng *et al*., (2018) who studied residual effects of various residual nutrient treatments on greengram in potato-greengram sequence. There was no significant influence due to various crop geometries and nutrient management treatments given to preceding finger millet crop on test weight of the succeeding horsegram. The present findings are supported by Patel (1994), who reported a non significant effect of various levels of spacing of bidi tobacco during *kharif* on yield and yield attributing characters of succeeding groundnut during summer. Further these results are in accordance with the earlier study conducted by Koireng *et al*. (2018) in potato-greengram sequence.

The seed yield of horsegram was significantly influenced by the nutrient management treatments given to preceding finger millet crop, but not by the finger millet crop geometries and their interaction. Similar findings were also reported by Patel, (1994). The present findings are also supported by Sathyapriya *et al*., (2019) who found non significant residual effect on growth and yield of succeeding bengalgram.

Significantly the highest seed yield of horsegram was recorded (915, 933 and 924 kg ha^{-1} during 2018-19, 2019-20 and in pooled data, respectively) when the preceding finger millet crop was applied with 125% RDF+FYM with wooden log treatment (S_6) which was found significantly superior to the rest of the treatments except the other integrated nutrient management practices with and without wooden log treatment (S_5, S_4 and S_3). Significantly the lowest grain yield of horsegram was recorded with the absolute control (646, 641 and 644 kg ha^{-1} during 2018-19, 2019-20 and in pooled data, respectively).

Horsegram being a leguminous crop and also having deep root system was able to meet a part of its requirement by way of nitrogen fixation and could be able to use the nutrients available from the deeper layers of soil resulting in appreciable yields in certain residual treatments. Similar results were also supported by Basavarajappa *et al*., (2003) in his study on performance of horsegram and castor crops on residual soil fertility of *kharif* foxtail millet.

The results clearly showed the combined application of manures and fertilizers produced higher yield. The response to FYM application may be attributed to the better residual availability of nutrients and its favourable effect on soil physical and biological properties, resulting in increased growth and yield attributes and ultimately higher yields. FYM increases the adsorptive power of soil for cations and anions particularly phosphates and nitrates and these were released slowly for the benefit of succeeding crops during entire crop growth period leading to higher yields (Seema *et al*., 2017). The results were also supported by Shafi *et al*., (2007), who reported strong carry over effect of nitrogen applied to previous wheat on crop yields of the following maize.

Table 2: Yield parameters of *rabi* horsegram as influenced by *kharif* finger millet crop geometry and nutrient management practices during 2018-19 & 2019-20 and in pooled data.

Treatments	Pods plant^{-1}			Seeds pod^{-1}			Test Weight (g)			Seed yield (kg ha^{-1})		
Crop geometry	2018-19	2019-20	Pooled data	2018-19	2019-20	Pooled data	2018-19	2019-20	Pooled data	2018-19	2019-20	Pooled data
M_1- 30×10 cm with 30 days old seedlings	28.40	28.63	28.51	4.88	4.90	4.89	28.16	27.81	27.99	837	860	849
M_2- 30×30 cm with 15 days old seedlings	26.81	27.31	27.06	4.98	4.81	4.90	28.70	28.71	28.70	808	811	809
M_3- 45×45 cm with 15 days old seedlings	25.04	25.86	25.45	5.09	4.96	5.03	28.39	27.77	28.08	784	780	782
S.Em±	0.90	0.75	0.79	0.14	0.11	0.12	0.75	0.43	0.69	22.26	23.37	21.06
CD (p = 0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CV (%)	15.48	12.68	13.38	13.00	10.68	11.21	12.05	7.06	11.21	12.60	13.11	11.87
Nutrient management												
S_0-Absolute control	21.29	22.33	21.81	4.89	4.84	4.87	27.87	27.33	27.60	646	641	644
S_1- FYM @ 10 tonnes ha^{-1} + *dravajeevamrutham*	23.94	25.02	24.48	4.93	4.87	4.90	28.14	27.63	27.89	735	729	732
S_2- S_1+ passing wooden log	25.73	26.18	25.96	4.96	4.82	4.89	28.22	27.79	28.01	753	752	752
S_3- FYM @ 10 tonnes ha^{-1} + 100% RDF	28.01	28.28	28.16	4.96	4.91	4.93	28.87	28.50	28.68	836	842	839
S_4- S_3+ passing wooden log	29.31	29.34	29.33	4.98	4.93	4.96	28.79	28.22	28.51	873	899	886
S_5- FYM @ 10 tonnes ha^{-1} + 125% RDF	29.42	29.47	29.45	5.09	4.93	5.01	28.47	28.57	28.52	909	923	916
S_6- S_5+ passing wooden log	29.53	30.23	29.88	5.07	4.93	5.00	28.54	28.63	28.59	915	933	924
S.Em±	0.90	0.90	0.92	0.14	0.15	0.17	0.88	0.83	0.79	27.73	26.82	29.96
CD (p = 0.05)	2.57	2.58	2.64	NS	NS	NS	NS	NS	NS	80	77	86
CV (%)	10.04	9.91	10.21	8.30	9.24	10.58	9.31	8.91	8.38	10.28	9.85	11.05
Interaction												
M × S	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
S × M	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

CONCLUSION

Concludingly, it is inferred from the study that integrated application of FYM @ 10 tonnes ha^{-1} + 125% RDF along with wooden log treatment (S_6) to finger millet in kharif resulted in higher yield and yield attributing traits of *rabi* horsegram and comparable with all the integrated nutrient management practices with and without wooden log treatment (S_5, S_4 and S_3).

FUTURE SCOPE

1. Research has to be continued for few more years to know the significant residual effect of nutrients in the sequence, on the same site involving the detailed study of physico-chemical properties of soil.
2. Research trials have to be conducted in farmers fields also for more significance and on farm comparison.
3. The transfer of the information and technology to the farmers should be done through agricultural extension services.

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Conflict of Interest. None.

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