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Productivity and Economics of horsegram (*Macrotyloma uniflorum*) as Influenced by Genotypes and Fertility Levels on Hill Region of Chhattisgarh

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ABSTRACT: A field experiment consisting of three genotypes *viz.* Indira Kulthi-1, HG-4 and HG-5 and three fertility levels *viz.* Control, 50% RDF + $MnSO_4$ @0.5% foliar spray and 100% RDF + $MnSO_4$ @ 0.5% foliar spray (20: 30: 10 kg ha^{-1} of N: P: K) was conducted at the Raj Mohni Devi College of Agriculture and Research Station, Ambikapur, Chhattisgarh during *kharif*, 2019 to find out the productivity and economics of rainfed horsegram. The experiment was laid out in split plot design with nine treatment combinations and three replications. The results indicated that horsegram variety HG-4 performing significantly higheryield and its yield attributing character *viz.*, number of pods $plant^{-1}$, number of seeds pod^{-1}, 1000-seeds weight (g) have been also over perform as compared to Indira Kulthi-1 and HG-5. The response of foliar spray of 100% RDF + $MnSO_4$ @ 0.5% foliar spray have been showed better as other nutrient levels (50% RDF + $MnSO_4$ @0.5% foliar spray and control) on growth and yield attributing characters *viz.* plant height, number of branches $plant^{-1}$, number of pods $plant^{-1}$, number of seeds pod^{-1}, 1000-seeds weight (g) and seed yield. Horsegram variety HG-4 with 100% RDF + $MnSO_4$ @ 0.5% foliar spray showed better on growth and yield and it should be recommended for the farmers of hill region of Chhattisgarh, India during *kharif*.

Keywords: Horsegram, Productivity, Genotypes and Fertility levels.

INTRODUCTION

Horsegram is one of under exploited grain legumes with great potential in sustainable agriculture by using improved cultivars of horsegram having better yield potential, adaptability, quality of produce, tolerance to biotic and abiotic factors and also adopting proper nutrient management practices. Underutilized and neglected horsegram crop has great potential to support small land holder of rural farming communities by providing nutritional food and income with sustaining the genetic resources needed to future environmental challenges (Kahane *et al*., 2013). Horsegram having good nitrogen fixing ability and recommended for delayed monsoon as a contingent crop (Umamaheswari *et al*., 2004) and an ideal crop for a double or sequence cropping in different climatic and geographic zones (Kumar, 2006). In Chhattisgarh horsegram occupies an area during *kharif* 38900 ha and *rabi* 25900 ha with an average productivity of 385 kg ha^{-1} and 335 kg ha^{-1} (Anonymous, 2018) and mostly grown in Sarguja, Jagdalpur, Kanker, Korba and Jashpur districts which together account for about 69.74 per cent area and 76.61 per cent production. Most of the farmers are growing local varieties of their own since long time. These varieties although are of moderately high yielding but mature late besides they are non- synchronous in pod maturity and susceptible to yellow mosaic virus disease and iron chlorosis. The productivity of pulse crop decreasing year by year due to decreasing of soil fertility especially macro and micronutrients, imbalanced use of fertilizer and occurrences of physiological disorders such as inefficient assimilates partitioning, poor setting of pod, excessive flower dropping and lack of nutrients at critical stages of growth leads to nutrient stress, poor growth and productivity were found to yield barriers of pulses (Ali *et al*., 2010). Macro and micronutrients are important because the crop of pulses to synchronized flowering, altered the source-sink relationship due to rapidly translocation of nutrients from leaves to the developing pods. Foliar application of micronutrients play a vital role to overcome the constraints in pulse production by stimulating of root development, nodulation, transformation of energy, metabolic processes, higher pod setting finally increasing the yield (Ravisankar *et al*., 2003). Hence, there is scope to enhance the productivity of horsegram by proper agronomic practices with suitable varieties and fertilizer management. Keeping this in view, the present study was undertaken to investigate the growth, yield and economics of horsegram (*Macrotyloma uniflorum*) as influenced by variety and fertility levels under rainfed condition of northern hill zone of Chhattisgarh.

MATERIALS AND METHODS

An experiment was conducted at Raj Mohni Devi College of Agriculture and Research Station, Ambikapur, Chhattisgarh during *kharif*, 2019. The soil of the experimental field was sandy loam with acidic nature (pH) and soil texture with low organic carbon (0.40 %) and nitrogen (220 kg ha^{-1}), medium in phosphorus (9 kg ha^{-1}) and high potassium (280 kg ha^{-1}). Treatments included combinations of three genotypes *viz* Indira Kulthi-1, HG-4 and HG-5as main-plot treatments and three fertility levels *viz.*

Control, 50% RDF + $MnSO_4$ @0.5% foliar spray and 100% RDF + $MnSO_4$ @ 0.5% foliar spray in sub-plot treatments, replicated three times with split plot design. Surface soil samples taken before sowing of horsegram crop were analysed for their physico-chemical properties employing standard procedure. The seeds sown manually using recommended seed rate (20 kg ha^{-1}) on third week of September in the furrows opened by hand drawn lines. Seeds are covered a thin layer soil by hand at the spacing of 25 cm row`s apart. Recommended dose of fertilizer (20:30:10 kg ha^{-1} N, P and K respectively) was applied simultaneously at the time of seed sowing as per treatment. Full quantity of phosphorus, potassium and half amount of nitrogen was applied as basal dose in horsegram crop. Remaining nitrogen was top dressed in 30 DAS at branching stage of horsegram. $MnSO_4$ was applied @ 0.5% foliar spray at 30 DAS and 45 DAS as per different treatment.

RESULTS AND DISCUSSION

Vegetative growth. Horsegram varieties and nutrient management had significant influenced on plant height and number of branches $plant^{-1}$at all the stages of observation (Table 1).The data revealed that among the varieties, HG-4 produced significantly taller plants and number of branches $plant^{-1}$over rest of the varieties. The lowest plant height and number of branches $plant^{-1}$was noted with HG-5. The varietal differences in plant height and number of branches $plant^{-1}$ might be due to genetic characters of variety or it has capability to respond better growth under optimum resource available. The similar findings was reported by Prakash *et al*., (2002); Noorjehan *et al*., (2017). As regards to nutrient management, the taller plants and number of branches $plant^{-1}$of horsegram were found with successive increase in nutrient levels. Nutrient application with 100% RDF + $MnSO_4$ @ 0.5% foliar spray produced significantly taller plants and number of branches $plant^{-1}$ as compare to other nutrient treatments. Lowest plants height was recorded under control. This might be due to adequate supply of nutrient with foliar spray that improves chlorophyll content which enables the crops photosynthetically more active and therefore higher dry matter accumulation, which was reflected in recording of superior values of plant height and number of branches $plant^{-1}$. These results confirm with the findings of Raut *et al*. (2016); Umamaheswari and Karthik, (2017) reported that enhanced level of nutrient available in the *rhizo*-ecosystem of the foliar applied nutrients resulting in better plant growth and development.

Yield attributing characters. The data on yield attributing characters significantly influenced by different treatments (Table 1). Close observation of data indicates that HG-4 recorded significantly higher number of pod $plant^{-1}$ (27.32), pod $length^{-1}$ (4.63 cm), number of seeds pod^{-1} (5.27) and 1000-seeds weight (28.56g) over other varieties. The lowest all the yield attributing characters was recorded under variety HG-5. Variation in yield attributing characters might be due to genetic makeup of genotypes and also each genotypes has their own yield potential which expressed in shape of plant growth and ultimately to seed yield. Similar results have also been reported by Nagaraju *et al*., (2002); Suthar *et al*. (2017). Among the various nutrient management practices, significantly higher number of pods $plant^{-1}$ (28.25), pod $length^{-1}$ (4.77 cm), number of seeds pod^{-1}(5.73) and1000-seed weight (28.07g) was obtained with application of 100% RDF + $MnSO_4$ @ 0.5% foliar spray. The lowest all yield attributing characters was noted under control. The higher yield attributing characters might be due to adequate and continuous nutrient availability through soil and foliar nutrition promotes the supply of assimilates to sink or yield container, thus enlarging the size of the yield structure. Similar findings have been reported by Umamaheswari *et al*., (2004). Foliar application of nutrients at the critical stage enhanced the number of floral buds, prevented the floral shedding by maintaining optimum bio-physiological conditions in plants (Umamaheswari and Karthik, 2017).

Grain yield. Significantly highest grain yield (7.82 q ha^{-1}) of horsegram was recorded with the HG-4 followed by Indira Kulthi-1 and the lowest grain yield was noted with HG-5 respectively (Table 1). The higher seed yield observed in HG-4 might be due to genetic makeup and significantly higher values of yield attributing characters like higher number of pods $plant^{-1}$, number of seeds pod^{-1}, number of branches $plant^{-1}$ and 1000- seeds weight which were responsible for higher yield. Genetic differences for seed yield have also been reported by Nagaraju *et al*. (2002); Suthar *et al*. (2017). Superiority of horsegram HG-4 over other two cultivars showed better yield could be ascribed to inherent genetic ability for efficient utilization of available resources and further translocation of such nutrients and photosynthates to reproductive parts. Similar findings were also reported by Keshava *et al*. (2007).

Among the various nutrient management practices, application of 100% RDF + $MnSO_4$ @ 0.5% foliar spray gave significantly highest grain yield (8.14 q ha^{-1}) over other nutrient levels treatments. While, the lowest grain yield was noted under control. Adequate and continuous nutrient availability through soil and foliar nutrition to meet the nutrient demand of the crop at the critical stage on-site, would have resulted in better growth and development of the crop and ultimately the yield attributing characters and yield. The balanced growth habit, which induced more flower and fruiting body production with timely supply of nutrients through foliar sprayed might have reduced shedding of flowers and fruits, which led to a positive source-sink gradient of photosynthates translocation. These favourable effects might have attributed for higher yield of horse gram under the balance nutrient with foliar spray. Similar findings were also reported by Umamaheswari and Karthik (2017) and Kumar (2007).

Economic analysis. Data showed that all the treatments had pronounced effects on the economics of horsegram during the experiment (Table 2). Similar cost of cultivation (₹18498ha^{-1}) was recorded in all horsegram genotypes but, among the nutrient treatments maximum cost of cultivation (₹20268ha^{-1}) was recorded when crop received 100% RDF + $MnSO_4$ @0.5% foliar spray. This might be due to higher cost of fertilizers at higher level of nutrients. Among the varieties, HG-4 brought out the maximum gross return (₹35200ha^{-1}), net return (₹16702 ha^{-1}) with a B:C (1.88) respectively, which excelled over those computed under other genotypes. This might be due to higher production potential of horsegram genotype accompanied with good monetary return. Raut *et al.* (2016) also had similar observation regarding the efficiency of horsegram genotype. The data further revealed that gross return, net return and benefit: cost ratio increased with increasing levels of nutrients compared to lower dose of nutrients. The maximum gross return (₹36650 ha^{-1}), net returns (₹16382 ha^{-1}) and B:C ratio (1.81) respectively, were obtained from the horsegram crop fertilized with 100% RDF + $MnSO_4$ @ 0.5% foliar spray. Highest values of cost of cultivation, gross return, net returns and B: C might be due to higher productivity without proportionate increase in cost of cultivation. Similar findings also reported by Chandrasekhar and Bangarusamy (2003).

Table 1: Vegetative growth, yield attributing characters and yield of horsegram as influenced by genotypes and fertility levels.

Treatment	Plant height (cm)	Number of branches plant^{-1}	No of pods plant^{-1}	Pod length^{-1} (cm)	No of seeds pod^{-1}	1000- seed weight(g)	Grain yield (q ha^{-1})
Genotypes							
V_1- Indira Kulthi-1	32.44	8.63	26.32	4.22	4.79	26.92	6.79
V_2- HG-4	34.33	9.01	27.32	4.63	5.27	28.56	7.82
V_3- HG-5	31.08	8.16	23.93	4.10	4.41	26.00	5.69
SEm±	**0.31**	**0.10**	**0.21**	**0.05**	**0.09**	**0.18**	**0.26**
CD (P= 0.05%)	**1.20**	**0.37**	**0.81**	**0.18**	**0.37**	**0.70**	**1.01**
Fertility levels							
F_1- Control	31.78	7.93	24.11	3.88	3.80	26.21	5.11
F_2- 50% RDF + $MnSO_4$ @ 0.5% foliar spray	32.56	8.70	25.21	4.31	4.93	27.21	7.04
F_3- 100% RDF + $MnSO_4$ @ 0.5% foliar spray	33.52	9.17	28.25	4.77	5.73	28.07	8.14
SEm±	**0.22**	**0.10**	**0.17**	**0.09**	**0.13**	**0.13**	**0.21**
CD (P= 0.05%)	**0.68**	**0.32**	**0.54**	**0.27**	**0.42**	**0.41**	**0.64**

Table 2: Cost of cultivation, gross return, net return and B:C ratio of horsegram as influenced by different genotypes and fertility levels.

Treatment	Cost of cultivation (₹ ha^{-1})	Gross return (₹ ha^{-1})	Net return (₹ ha^{-1})	B: C ratio
Genotypes				
V_1- Indira Kulthi-1	18498	30560	12062	1.63
V_2- HG-4	18498	35200	16702	1.88
V_3- HG-5	18498	25600	7102	1.38
SEm±		**1163**	**1163**	**0.05**
CD (P= 0.05%)		**4565**	**4565**	**0.18**
Fertility levels				
F_1- Control	15840	23010	7170	1.45
F_2- 50% RDF + $MnSO_4$ @ 0.5% foliar spray	19385	31700	12315	1.64
F_3-100% RDF + $MnSO_4$ @ 0.5% foliar spray	20268	36650	16382	1.81
SEm±		**939**	**939**	**0.05**
CD (P= 0.05%)		**2893**	**2893**	**0.16**

Market price of grain (₹ q^{-1}): 4500

CONCLUSION

In light of the results obtained from present investigation, it is concluded that horsegram varieties HG-4 and Indira Kulthi-1found suitable for getting higher production. Among the different nutrient levels 100% RDF+ $MnSO_4$ @0.5% foliar spray was found superior with respect to growth performance, yield attributes which produced higher grain yield net profit to other nutrient levels in *kharif* season on sandy loamy (*Inceptisols*) soil under northern hills of Chhattisgarh agro-climatic condition.

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