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RESEARCH PAPER

Production potential and economics of mustard under different cropping sequences with reference to integrated nutrient management

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Abstract : The experiment was conducted during *Rabi* season of 1999-2000 and 2000-01 on sandy loam soil at JNKVV, College of Agriculture, Farm, Gwalior (M.P.) to study the effect of different cropping systems and fertility levels on yield, yield attributes and economics of mustard (var. Pusa bold). Results showed that the maximum seed yield (23.05 q ha^{-1}), oil content (40.39%), net return (Rs. 23661 ha^{-1}), energy output (74024 MJ ha^{-1}) and B:C ratio (3.19) were observed in blackgram – mustard followed by Peral millet-mustard cropping system. Fertilizer application of 50% RD + Azotobacter + PSB @ 20g kg^{-1} seed, resulted in maximum net return (Rs. 20797 ha^{-1}) and B.C. ratio (2.99) as compared to higher application of fertilizers.

Key Words : Cropping sequences, INM, Economic, Energy input output, Yield

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INTRODUCTION

Mustard crop is grown under monocropping system in the northern M.P. Nearly 2.85 lakh hectares of land is kept fallow in *Kharif* followed by mustard in *Rabi*, resulting in low cropping intensity and productivity. Therefore, to replace this traditional practice and to increase the cropping intensity as well as profit per unit area. Under sufficient irrigated system through canal, tube well and other resources, there exists enormous possibility of enhancing cropping intensity of the northern Madhya Pradesh in double cropping system of cultivation.

Thus, biofertilizers can make significant contribution towards the development of strategies this for productivity improvement, which do not lead to an exponential rise in consumption of non-renewable forms of energy. Nutrient supply through the biofertilizers is dependent on energy from renewable resources, such as products of photosynthesis and organic matte in the soil. Therefore, it is the need of the time to evolve and adopt a strategy of integrated nutrient management for improving the productivity of farmlands by using a judicious combination of chemical fertilizers, organic manures and bio fertilizers. The experiment were conducted to study the effect of cropping system and integrated nutrient management on yield, yield attributes and economics of mustard in northern Madhya Pradesh.

MATERIAL AND METHODS

A field experiment was conducted at JNKVV, College of Agriculture, Farm, Gwalior (M.P.) during *Rabi* season of 1999-2000 and 2000-01. The experiment was laid out in a Split Plot Design with three replications. The plot size was 4.5m x 3.6 m. The three cropping system (C_1: Blackgram–mustard, C_2: Soyabean– mustard and C_3: Pearl millet – mustard) were kept as main plots and three fertility levels (F_1:50% Recommended dose of fertility (RDF) + Azotobactor + Phosphorous solubilising bacteria (PSB0, F_2:175% RDF+ Azotobactor + PSB and F_3 : 100% RDF through chemical fertilizers as sub plots. The soil was sandy loam having 175 kg ha^{-1} available N, 16 kg ha^{-1} P_2O_5 and 211 kg. ha^{-1} available K_2O. A basal does of 40 kg N : 40 kg P_2O_5 and 20 kg ha^{-1} was applied. The crop was sown on 11 October (Blackgram – mustard and pearl millet – mustard) and 4 November (Soybean-mustard) during 1999-2000 and 19 October (Blackgram – mustard and pearlmillet – mustard) and 9 November (Soybean – Mustard) during 2000-01. All the treatments were sown at 30 cm row spacing and maintained a uniform plant population of about 3.3 lakh ha^{-1} by thinning. The crop received three irrigations including on pre-sowing. A dose of 40 kg N ha^{-1} was applied as top dressing at 40 days after sowing (Pre-flowering stage). Plant protection measures were undertaken as and when found necessary. The crop was harvested at maturity. Data on yield attributing parameters and seed yield were collected and statistically analysed.

RESULTS AND DISCUSSION

There was significant effect of cropping system on the yield attributing characters and yield of mustard (Table 1). It was also found that there was no significant effect of fertility levels on the yield of mustard except oil content which showed significant of cropping system and fertility levels. There was significant effect of cropping system number of branches plant^{-1}, number of siliquae plant^{-1}, seed yield plant^{-1}, stover yield plant^{-1} and oil content. Number of branches 15.73 plant^{-1} and 15.70 plant^{-1} in Blackgram – mustard followed by pearl millet – mustard 175.71 plant^{-1}. Seed yield of 12.81 g. plant^{-1} was maximum with blackgram – mustard cropping system followed by Pearl millet – mustard cropping system 12.39 g plant^{-1}. Maximum oil content of 4.30 per cent was recorded with Blackgram – mustard followed by Pearl millet – mustard cropping system (40.10%). In case of fertility levels whether 50% RD + Azotobacter + PSB or 75% RD + Azotobacter + PSB or 100% RD through chemical fertilizer had no significant effect on yield contributing factors except oil content, with increase fertility level oil content in mustard seed decreased (41.04 to 39.15%) similar finding are reported by Gangwar and Kumar (1986).

Table 1 : Growth and yield attributing character as affected by cropping system and fertility levels on mustard

(Pooled data of 1999-2000 and 2000-01)

Treatments	No. of branches plant^{-1}	No. of siliquae plant^{-1}	Length of siliqua (cm)	No. of seeds siliqua^{-1}	Seed yield plant^{-1} (g)	Stover yield plant^{-1} (g)	1000 seed weight (g)	Oil % in seed
Cropping systems								
Blackgram – mustard (C_1)	15.73	177.34	4.94	13.23	12.81	48.78	5.85	40.39
Soybean – mustard (C_2)	12.42	135.33	4.52	12.60	9.04	35.51	5.86	39.73
Pearlmillet – mustard (C_3)	15.70	175.71	4.91	13.09	12.39	48.32	5.86	40.10
S.E.±	0.40	1.06	0.35	0.77	0.17	0.51	0.35	0.09
C.D. (P=0.05)	1.15	3.07	NS	NS	0.50	1.54	NS	0.31
Fertility levels								
50% RD + Azoto. + PSB (F_1) @ 20 g kg^{-1} seed	14.32	161.48	4.78	12.95	11.43	43.09	5.77	41.04
75% RD + Azoto. + PSB (F_2) @ 20 g kg^{-1} seed	14.57	162.77	4.79	12.90	11.47	44.41	5.80	40.02
100% RD (F_3)	14.96	164.04	4.80	13.06	11.34	44.20	5.81	39.15
(Through chemical fertilizers)								
S.E.±	0.11	0.41	0.06	0.39	0.04	0.12	0.12	0.31
C.D. (P=0.05)	NS	NS	NS	NS	NS	NS	NS	0.91

NS= Non-significant

Table 2 : Yield and economics as affected by cropping system and fertility levels on mustard (Pooled data of 1999-2000 and 2000-01)

Treatments	Seed yield (q ha^{-1})	Stover yield (q ha^{-1})	Harvest index (%)	Cost of cultivation (Rs. ha^{-1})	Gross return (Rs. ha^{-1})	Net return (Rs. ha^{-1})	B:C ratio	Energy input (MJ ha^{-1})	Energy output (MJ ha^{-1})	Energy input output ratio
Cropping systems										
Blackgram – mustard (C_1)	23.05	72.86	25.09	7396	31057	23661	3.19	18419	74024	4.02
Soybean – mustard (C_2)	16.53	54.47	23.29	7480	22310	14830	1.98	20484	64060	3.12
Pearlmillet – mustard (C_3)	20.21	67.72	22.99	7291	27288	19997	2.74	23076	96947	4.22
S.E.±	0.85	1.75	0.92	-	-	1187	0.31	-	-	-
C.D. (P=0.05)	2.47	5.05	NS	-	-	3459	0.87	-	-	-
Fertility levels										
50% RD+Azoto.+ PSB(F_1)@20 g kg^{-1} seed	20.62	63.00	24.16	6954	27751	20797	2.99	19316	78514	4.05
75% RD+Azoto.+ PSB(F_2)@20 g kg^{-1} seed	20.29	64.86	23.75	7444	27349	19905	2.67	20660	77731	4.09
100% RD(F_3) (Through chemical fertilizers)	20.35	67.20	23.46	7959	27463	19504	2.45	22005	78787	3.56
S.E.±	0.42	0.91	0.40	-	-	649	0.23	-	-	-
C.D. (P=0.05)	NS	NS	NS	-	-	NS	NS	-	-	-

NS= Non-significant

Data presented in Table 2 showed that maximum seed yield of 23.05 q ha^{-1} was recorded in Blackgram – mustard cropping system followed by Pearl millet-mustard cropping system. The lowest seed yield of 16.53 q ha^{-1} was recorded with soybean mustard cropping system. The similar pattern in stover yield was also observed. Maximum gross return (Rs. 31057 ha^{-1}), net return (Rs. 23661 ha^{-1}) and B.C. ratio (3.19) was found in Blackgram – mustard cropping system. The lowest gross return (Rs. 2231 ha^{-1}), net return (Rs. 14830 ha^{-1}) and B:C ratio (1.98) were recorded in Soybean – mustard cropping system. There was no significant effect of fertility levels whether that 50% RD + Azotobacter + PSB or 75% RD + Azotobacter + PSB or 100% RD through chemical fertilizer. Maximum gross return (Rs. 27757 ha^{-1}), net return (Rs. 20797 ha^{-1}) and B:C ratio (2.99) were observed with 50% RD + Azotobacter + PSB as compared to 75% RD + Azotobacter + PSB and 100% through chemical fertilizer. Over all cropping system of Blackgram – mustard with fertility level 50% RD + Azotobactor + PSB resulted in maximum yield resulting in highest net return and B:C ratio.

Low yield of mustard after soybean might be due to late sowing of mustard as soybean take 105 days for full maturity. As regard with the influence of different fertility levels upon yield and yield attributing characters of mustard crop, the treatment differences were non-significant. This shows that bio fertilizers played their unique role with respect to the addition of more nitrogen and availability of more phosphorus to the crop plants and thus proved the best substitute of chemical fertilizer upto extent of 25 to 50 per cent.

Amongst the crop sequences, maximum EI (23076 MJ ha^{-1}) was recorded in case of pearl millet - mustard, followed by soybean- mustard, (20484 MJ ha^{-1}) and then blackgram-mustard (18419 MJ ha^{-1}). The EI was enhanced with the enhancement in fertility levels in terms of chemical fertilizers *i.e.* from F_1 (50%) to F_3 (100%). As such the maximum EI (22005 MJ ha^{-1}) was noted in case of F_3. Amongst the three crop sequences, mustard grown after Pearl millet (PM- M sequence) recorded the highest EO (96947 MJ ha^{-1}). This was followed by mustard grown after soybean (S-M sequence), the EO being 74024MJ ha^{-1}.The maximum energy input output ratio was recorded 4.22 in Pearl millet –Mustard crop sequence.

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