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Lewade AD
M.Sc. (Agronomy) Scholar, College of Agriculture, VNMKV, Department of Agronomy, Vasantrao Naik Marathwada Krishi Vidhyapeeth, Parbhani, Maharashtra, India

Narkhede WN
Head, Department of Agronomy, VNMKV, Department of Agronomy, Vasantrao Naik Marathwada Krishi Vidhyapeeth, Parbhani, Maharashtra, India

Mehere SS
M.Sc. (Horticulture) Scholar, College of Agriculture, VNMKV, Department of Agronomy, Vasantrao Naik Marathwada Krishi Vidhyapeeth, Parbhani, Maharashtra, India

Masurkar AU
B.Sc. (Agriculture) Scholar, Ramkrishna Bajaj College of Agriculture, Pipri, Wardha, Dr. PDKV, Akola, Maharashtra, India

Corresponding Author:
Lewade AD
M.Sc. (Agronomy) Scholar, College of Agriculture, VNMKV, Department of Agronomy, Vasantrao Naik Marathwada Krishi Vidhyapeeth, Parbhani, Maharashtra, India

Effect of various land configuration and foliar sprays on economics of soybean + pigeonpea intercropping under rainfed conditions

Lewade AD, Narkhede WN, Mehere SS and Masurkar AU

Abstract
Present experimentation was conducted during *kharif* 2016 at farm, AICRP on Integrated Farming Systems, VNMKV, Parbhani (M.S.) on clayey textured soil to study the "effect of land configurations and foliar sprays on Soybean (*Glycine max* (L.) Merrill) + Pigeonpea (*Cajanus cajan* (L.) Mill sp.) Intercropping system under rainfed condition". The experiment consisted of 3 main plots and 4 sub main plot treatments in a split plot design which were replicated thrice. Main treatments consist of three land configuration *viz.,* Flat Bed & Ridges and Furrow with 4:2 soybean + pigeonpea intercrop ratio and Broad Bed Furrow with 2:1 soybean + pigeonpea intercrop ratio and four foliar sprays *viz.,* Water, Kaolin @ 6%, KNO_3 @ 2% and $MgCO_3$ @ 5% applied to sub plots. The outcome revealed that cultivation of intercrop on BBF produced higher soybean equivalent yield, gross monetary returns, net monetary returns and B:C ratio. The spray of KNO_3 2% resulted in significantly higher soybean equivalent yield, gross monetary returns, net monetary returns and B:C ratio over sprays of water, Kaolin @ 6% and $MgCO_3$ @ 5%. Because of high cost of $MgCO_3$, it incurred more cost of cultivation, thus low net monetary returns and benefit: cost ratio recorded in this treatment. Interaction effect between land configuration and foliar spray were non significant.

Keywords: Intercropping, land configuration, foliar sprays, BBF, KNO_3, soybean equivalent yield, gross monetary returns, net monetary returns, B:C ratio

Introduction
Marathwada region of Maharashtra receives uncertain rainfall round the year. Scarcity of moisture for crop production is one of the major constraints in farming. Late onset, prolonged dry spell, early withdrawl, erratic distribution are the major vagaries that the region faces commonly since decades. As a result of that, the crops with low water requirement and shorter duration are mostly preferred by the farmers. Soybean is one of the short duration drought resistant crop and pigeonpea is well known for its drought tolerance even though it is long duration crop.

Intercropping is practice of growing two or more than two crops on same piece of land with a definite row proportion in a given period. Now a day it is serving as a best tool to overcome the vagaries of monsoon. If two crops, out of which one of short and one of long duration are taken as intercrop, it serves as an insurance in case of crop failure of either crop due to drought or water scarcity. Intercropping prevents complete failure of crops in aberrant weather situations as well as it makes effective utilization of resources like land, labour and capital and finally contributes more into the yield.

Moisture conservation is one of the major aspect for growing crops and producing sufficient yields in the dryland tracts. For moisture conservation various techniques like ridges and furrow, broad bed furrow are practiced. Out of these BBF technology is very effective on black cotton soils that reduces or prevents the water losses and increases water intake. These provides two way benefits; one conservation of moisture receiving during peak rainfall periods and another disposal of excessive rains from the field successfully. For the purpose for conservation of moisture inside plant body by reducing transpirational moisture loss use of various antitranspirants is recommended. Out of that KNO_3, $MgCO_3$, Kaolin, Water are commonly used examples having various modes of operation like regulating stomatal openings, increasing the reflectance (albedo), maintaining the favourable water balance inside plant.

Materials and methods

The experimental site was clayey textured with low nitrogen, medium phosphorus and adequate potash content. The experiment was laid out in split plot design with 3 main plot and 4 sub plot treatments. Number of replications were 3 and total number of plots were 36. Land configurations i.e. flat bed, ridges and furrow and BBF were main plot treatments and foliar sprays i.e. water, kaolin, KNO_3 and $MgCO_3$ were taken as sub plot treatments. These sprays were given @ 45 and 65 days after sowing of crop. In flat bed and ridges and furrow intercrop ratio of 4:2 and in BBF intercrop ratio of 2:1 was maintained. Crops were sown on 25th June 2016 with recommended spacing and seed rates. Variety used for soybean was MAUS-71 and for pigeonpea was BDN-711. A RDF of 30:60:30 kg NPK/ha was applied to the crops. Periodic intercultivation and weedings alongwith plant protection measures were followed in the field. Observations were taken at the interval of every 15 and 30 days at soybean and pigeonpea respectively till harvesting of crops.

Result and Discussion

Effect of land configurations on economics of soybean + pigeonpea intercropping system

The data on gross monetary returns, net monetary returns, cost of cultivation and Benefit: Cost ratio is presented in table 2.0. It reveals that among land configurations, broad bed furrow layout with 2:1 soybean: pigeonpea intercropping ratio recorded highest gross monetary returns, net monetary returns as well as benefit: cost ratio. This may be due to the conservation of moisture in broad bed furrow over ridges and furrow and flat bed which resulted in higher yields of both the crops and ultimately higher equivalent yield obtained. Simultaneously ridges and furrow incurred highest cost of cultivation among all other land configuration. This is due to more cost required for preparation of ridges and furrow layout over BBF and Flat sowing. As BBF layout produced more equivalent yield and thus GMR with less cost of cultivation, it has highest benefit: cost ratio. Kumar *et al.* (2012) [3] and Sharma *et al*. (2012) [5] reported similar findings in pigeonpea + green gram intercropping.

Table 1.0: Yield produced from Soybean, Pigeonpea and Equivalent Yield of Soybean + Pigeonpea intercropping system.

Treatments	Soybean Yield (kg/ha)	Pigeonpea Yield (kg/ha)	Soybean Equivalent Yield (kg/ha)
Land configurations (L)			
L_1: Flat bed (4:2 ratio)	1198	785	2626
L_2: Ridges and furrow (4:2 ratio)	1314	839	2841
L_3: BBF (2:1 ratio)	1588	933	3286
SE±	35.14	19.16	73.11
CD at 5%	104.25	56.85	216.89
Foliar sprays (F)			
F_1: Water	1220	779	2638
F_2: Kaolin @ 6%	1376	848	2920
F_3: KNO_3 @ 2%	1529	955	3266
F_4:$MgCO_3$ @ 5%	1341	827	2846
SE±	40.42	27.95	87.14
CD at 5%	119.91	82.93	258.52
Interaction (L×F)			
SE±	70	48.42	150.93
CD at 5%	NS	NS	NS
General mean	1366	852	2918

Table 2.0: Effect of land configurations and foliar sprays on economics of soybean+pigeonpea intercropping system;

Treatments	GMR (× 10^3 Rs/ha)	Cost of cultivation (× 10^3 Rs/ha)	NMR (× 10^3 Rs/ha)	B:C ratio
Land configurations (L)				
L_1: Flat bed (4:2 ratio)	75.60	36.27	39.33	2.1
L_2: Ridges and furrow (4:2 ratio)	81.68	37.95	43.73	2.2
L_3: BBF (2:1 ratio)	94.36	36.56	57.80	2.6
SE±	2.09	-	1.64	-
CD at 5%	6.21	-	4.87	-
Foliar sprays (F)				
F_1: Water	75.93	27.30	48.63	2.8
F_2: Kaolin @ 6%	83.95	30.59	53.36	2.7
F_3: KNO_3 @ 2%	93.80	28.50	65.30	3.3
F_4:$MgCO_3$ @ 5%	81.83	61.30	20.53	1.3
SE±	2.47	-	2.23	-
CD at 5%	7.34	-	6.62	-
Interaction (L×F)				
SE±	4.28	-	3.87	-
CD at 5%	NS	-	NS	-
General mean	83.88	36.93	46.95	2.3

Effect of foliar sprays on economics of soybean + pigeonpea intercropping system

In case of foliar sprays, application of KNO_3 @ 2% recorded highest Soybean equivalent yield and thus gross monetary returns as well as benefit: cost ratio. The probable reason behind enhanced economic returns may be the improvement in growth and yield attributes of both the crops i.e. soybean and pigeonpea because of the significant role played by potassium nitrate in plant`s water management. It encouraged establishment and branching of root system that better absorbed water. Being responsible for opening and closing of stomata, it minimized plant transpiration and reduced water

requirement and ultimately it increased the yield. Similar results were obtained from potassium nitrate by Reddy *et al.* (2004), Gowthami *et al.* (2014) [1] and Kaur *et al.* (2015) [2]. The treatment F_4 (application $MgCO_3$ @ 5%) recorded highest cost of cultivation because higher cost of chemical and thus it recorded the lowest net monetary returns and benefit cost ratio. The results are in confirmity with earlier findings of Sanbagavalli *et al.* (2017) [4].

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