The Pharma Innovation Journal 2022; SP-11(11): 1586-1588

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; SP-11(11): 1586-1588

www.thepharmajournal.com
Received: 20-08-2022
Accepted: 25-09-2022

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Effect of land configuration and weed management practices on yield and economics of sesame

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Abstract
A field experiment was carried out at Instructional Farm, Dau Kalyan Singh College of Agriculture and Research Station, Alesur, Bhatapara (Chhattisgarh) during *kharif* season of 2021 to assess the effect of land configuration and weed management practices on yield and economics of sesame. The experiment was laid out in Factorial RBD with three replications. First factor was land configuration *viz.*, flat bed and broad bed furrow system and second factor was weed management practices *viz.*, weedy check, Pendimethalin 30 EC @ 1000 g a.i. ha^{-1} (PE) - Hand weeding at 30 DAS, Pendimethalin 30 EC @ 1000 g a.i. ha^{-1} (PE) - Quizalofop-ethyl 5 EC @ 50 g a.i. ha1 (PoE), Oxyflourfen 23.8 EC @ 75 g a.i. ha^{-1} (PE) - Quizalofop-ethyl 5 EC @ 50 g a.i. ha^{-1} (PoE) and Weed free. The results revealed that Broad bed and furrow system performed best in respect to growth, yield and economics of sesame amongst weed management practices, Pendimethalin 30 EC @ 1000 g a.i. ha^{-1} (PE) - Hand weeding at 30 DAS proved best while weed free was superior. The interaction effect of Broad bed and furrow system + weed free reflected in the maximum net return while the B:C ratio was recorded the highest due to the interaction effect of Broad bed and furrow system + Oxyflourfen 23.8 EC @ 75 g a.i. ha^{-1} (PE) - Quizalofop-ethyl 5 EC @ 50 g a.i. ha^{-1} (PoE).

Keywords: economics, herbicide combinations, land configuration, weed management

Introduction
Sesame (*Sesamum indicum* L.) is the oldest indigenous oilseed crop and has been cultivated for the longest time in India. Sesame seed is regarded to be the world's oldest oilseed crop. The oil is used as the base for Ayurvedic preparations and known as the Queen of oils. Sesame seeds are called as the seed of immortality. Sesame has the highest oil content (55 %) and protein content (25 %) among oilseed crops (Raja *et al*. 2007 and Wei *et al*. 2015) [8, 13]. The oil of sesame is also referred as poor man's substitute for ghee.

The area, production and productivity of sesame in India during 2018-19 are 1.60 million hectare, 0.76 million tonens and 473 kg ha^{-1} respectively (Anonymous, 2020) [1]. Largest sesame producing states are Gujarat (contributes 22.3% of total production) followed by West Bengal, Karnataka, Rajasthan and Madhya Pradesh. In Chhattisgarh it is grown in an area of 24.92 thousand ha with production of 8.37 thousand tonnes and productivity of 336 kg ha^{-1} during 2017-18.

Land configuration helps for maximizing rainfall infiltration, minimizing erosion, total runoff, facilitates drainage and ultimately improves water use efficiency. Modification of land through broad bed furrow and ridges and furrows would reduce the soil related problems, improves *in situ* soil water conservation and thus higher crop growth and yield. The raised bed zone of broad bed and furrow system is better aerated with lower penetration resistance and favorable for deeper seed placement and better crop emergence (Jayapaul *et al*., 1996) [4].

Weeds are one of the major constraints to reduce *sesam* crop productivity because they compete with crop plants for moisture, nutrients, light, and space, resulting in a 50-75 percent yield loss (Bhadauria *et al*., 2012) [2]. Though manual weeding is effective and eco-friendly yet they are tedious and time consuming. Chemical weed management is more favourable and effective as they are quick in action, selective in nature, cost effective and efficient to control weeds during the critical period (Omezzine *et al*., 2011) [7].

Keeping there facts in view the present investigation is undertaken to examine the "Effect of land configuration and weed management practices on yield and economics of sesame."

Material and Methods

Field experiment was carried out during *kharif* season of 2021 at the Instructional Farm, Dau Kalyan Singh College of Agriculture and Research Station, Alesur, Bhatapara (Chhattisgarh). Bhatapara is situated in South Eastern part of Chhattisgarh at 21°73′ N latitude and 81°94′ E longitude at an attitude of 293.82 m above the mean sea level (MSL). The climate of the region is sub-humid to semi-arid. The region receives an annual rainfall of 1326 mm. The soil of the experimental site was clay (*Vertisols*) in texture, neutral in reaction (pH 7.47), low in organic carbon (0.30) and available nitrogen (112.8 kg ha^{-1}), medium in available phosphorus (12.74 kg ha^{-1}) and high in available potassium (385 kg ha^{-1}). The experiment was laid out in Factorial Randomized Block Design with three replications. The treatments comprised of land configuration (flat bed and broad bed furrow) with weed management (weedy check, Pendimethalin 30 EC @ 1000 g a.i. ha^{-1} (PE) - Hand weeding at 30 DAS, Pendimethalin 30 EC @ 1000 g a.i. ha^{-1} (PE) - Quizalofop-ethyl 5 EC @ 50 g a.i. ha1 (PoE), Oxyflourfen 23.8 EC @ 75 g a.i. ha^{-1} (PE) - Quizalofop-ethyl 5 EC @ 50 g a.i. ha^{-1} (PoE) and Weed free). The sowing was done manually by line sowing the sesame seed mixed with sand (1:3). 5 kg ha^{-1} seed of sesame variety 'GT-5' was used. A uniform dose of 50 kg N, 40 kg P_2O_5 and 30 kg K_2O ha^{-1} was applied through urea, single super phosphate and muriate of potash, respectively. The half of the dose of nitrogen along with entire dose of phosphorus and potassium were applied as basal at the time of sowing and the remaining half of the nitrogen was top dressed on 30 DAS. Observations on yield and economics of sesame on influenced by various land configuration and weed management practices were recorded using the standard procedure. Minimum support price (□7307 q^{-1}) of sesame during experimental period was taken to compute the economics. All the experimental observations recorded were subjected to statistical analysis as per the procedure laid down by Gomez and Gomez (1984) [3].

Result and Discussion

The higher grain, stover and biological yields were recorded (Table 1) with Broad bed and furrow system found significantly superior over Flat bed system. Yields were significantly higher (675.4 kg ha^{-1}) under herbicidal combination of Pendimethalin 30 EC @ 1000 g a.i. ha^{-1} (PE) - Hand weeding at 30 DAS which was significantly superior over rest of the herbicidal treatments while weed free was superior. The interaction effect of Broad bed and furrow system + weed free recorded the maximum grain and biological yield which was found significantly superior over other combinations of land configuration systems and weed management practices. However harvest index (%) of sesame did not differ significantly among the treatments (Table 1). Teame *et al.* (2021) [12] also recorded the maximum yields at the ridge and furrow land configuration technique, even though insignificantly differ from bed furrow land configuration, whereas the lowest was recorded at flat could be due to the conserved moisture in all sesame growth phases that had a role in converting all sesame flowers to capsules. This finding is in harmony with Malik *et al.* (2003) [5]. Higher yields due to the application of herbicide and cultural practices resulting in reduced crop weed competition and creating good environment for better growth of plant which gave increased yield components *viz.*, number of capsules $plant^{-1}$, number of seeds $capsule^{-1}$ and test weight as a result of reduced competition for growth resources by weeds leading to efficient translocation of assimilates from source to developing capsules or seeds. The lowest seed yield of sesame was registered under weedy check, which was significantly lesser than the rest of the wed management practices. This might be due to heavy weed infestation which offered severe competition between crop and weed for growth resources, resulting in poor partitioning of photosynthates from source to sink. These results are in agreement with those of Sheoran *et al.* (2012) [10] and Sahu *et al.* (2019) [9].

Land configuration of Broad bed and furrow system recorded significantly higher net return and B:C ratio as compared to Flat bed system (Table 1). Among herbicidal combinations, significantly higher net return was recorded under Pendimethalin 30 EC @ 1000 g a.i. ha^{-1} (PE) - Hand weeding at 30 DAS (□ 23835 ha^{-1}) being at par with Oxyflourfen 23.8 EC @ 75 g a.i. ha^{-1} (PE) - Quizalofop-ethyl 5 EC @ 50 g a.i. ha^{-1} (PoE) (□ 23587 ha^{-1}) but significantly superior over Pendimethalin 30 EC @ 1000 g a.i. ha^{-1} (PE) - Quizalofop-ethyl 5 EC @ 50 g a.i. ha^{-1} (PoE) (□ 17411 ha^{-1}) while the B:C ratio was maximum for Oxyflourfen 23.8 EC @ 75 g a.i. ha^{-1} (PE) - Quizalofop-ethyl 5 EC @ 50 g a.i. ha^{-1} (PoE). Further, weed free had maximum net return and were significantly superior over rest of the treatment. The interaction effect of Broad bed and furrow system + weed free reflected in the maximum net return which was found at par with Broad bed and furrow system + Pendimethalin 30 EC @ 1000 g a.i. ha^{-1} (PE) - Hand weeding at 30 DAS and Flat bed system + weed free) but significantly superior over other combinations. However the B:C ratio was recorded the highest due to the interaction effect of Broad bed and furrow system + Oxyflourfen 23.8 EC @ 75 g a.i. ha^{-1} (PE) - Quizalofop-ethyl 5 EC @ 50 g a.i. ha^{-1} (PoE). Net returns resulting higher from weed management practices could be attributed to increased might be due to increased seed yield as a result of effective control of all the weeds and reduced cost of cultivation under these treatments. The lowest net returns were realized with weedy check, which was significantly lesser than the rest of the weed management practices due to reduced seed yield as a result of heavy weed infestation. The highest benefit-cost ratio was computed with pre-emergence application of oxyfluorfen 23.8 EC @ 75 g a.i. ha^{-1} *fb* quizalofop-ethyl 5 EC @ 50 g a.i. ha^{-1} applied as post emergence which was significantly higher than the rest of the weed management practices due to lesser cost of weeding in these treatments. These findings are in agreement with the findings of Mruthul *et al.* (2015) [6] and Singh *et al.* (2018) [11].

Table 1: Yields and economics of sesame as influenced by land configuration and weed management practices

Treatment	Yields				Economics	
	Seed yield (kg ha^{-1})	Stover yield (kg ha^{-1})	Biological yield (kg ha^{-1})	Harvest index (%)	Net returns (Rs. ha^{-1})	Benefit: cost ratio
Land configuration						
C_1– Flat bed system	582.4	1170	1752	33.21	20015	0.889
C_2 - Broad bed and furrow system	659.8	1311	1991	33.25	23681	0.965
SE(m) ±	7.591	19.72	20.09	0.350	555	0.020
CD (*P*= 0.05)	22.55	58.58	59.69	NS	1648	0.058
Weed management practices						
W_1- Weedy check	483.7	966.4	1450	33.44	15896	0.816
W_2- Pendimethalin 30 EC @ 1000 g a.i. ha^{-1} (PE) - Hand weeding at 30 DAS	675.4	1383	2109	32.02	23835	0.929
W_3- Pendimethalin 30 EC @ 1000 g a.i. ha^{-1} (PE) - Quizalofop-ethyl 5 EC @ 50 g a.i. ha^{-1} (PoE)	528.3	1062	1591	33.23	17411	0.823
W_4- Oxyflourfen 23.8 EC @ 75 g a.i. ha^{-1} (PE) - Quizalofop-ethyl 5 EC @ 50 g a.i. ha^{-1} (PoE)	603.1	1200	1803	33.47	23587	1.149
W_5- Weed free	814.8	1591	2405	34.00	28510	0.919
SE(m) ±	12.03	31.18	31.76	0.554	877	0.031
CD (*P*=0.05)	35.66	92.63	94.38	NS	2606	0.092
Interaction						
SE(m) ±	16.97	44.09	44.92	0.78	1240	0.044
CD (*P*=0.05)	50.43	NS	133.46	NS	3685	0.130

Conclusion

Significantly the higher yield of sesame were obtained from Broad bed and furrow system found compared to Flat bed system of land configuration. Among the weed management practices weed free found superior over all the weed management practices. Pendimethalin 30 EC @ 1000 g a.i. ha^{-1} (PE) - Hand weeding at 30 DAS (59.10) found at par with Oxyflourfen 23.8 EC @ 75 g a.i. ha^{-1} (PE) - Quizalofop-ethyl 5 EC @ 50 g a.i. ha^{-1} (PoE) (55.03) but significantly superior over Pendimethalin 30 EC @ 1000 g a.i. ha^{-1} (PE) - Quizalofop-ethyl 5 EC @ 50 g a.i. ha^{-1} (PoE). The highest gross return and net return were realized with combination of broad bed and furrow system and Pendimethalin 30 EC @ 1000 g a.i. ha^{-1} (PE) - Hand weeding at 30 DAS, while the highest benefit cost ratio were computed with combination of broad bed and furrow system and Oxyflourfen 23.8 EC @ 75 g a.i. ha^{-1} (PE) - Quizalofop-ethyl 5 EC @ 50 g a.i. ha^{-1} (PoE).

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