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Role of planting pattern and weed control methods on growth and yield of mustard: A review

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Abstract
Next to cereal, oil seed crops play crucial role in Indian economy. Among various factors responsible for the productivity of mustard are weed control methods and planting patterns. Arrangement of plants are not only responsible for increase in crop productivity but also help to reduce infestation of weeds, saving of water when crop are planted on ridges or beds. Spacing improves the conservation of natural weapons like water, light and nutrients, etc. The different methods of planting pattern influence the yield and growth characters. The -infestation of weeds in crop reduce the number of leaves, number of branches, siliqua per plant, seed/siliqua, oil quality, yield attributes of mustard. In Integrated Weed Management, chemical weed control methods and planting on raised bed play successive role in obtaining higher yield in mustard.

Keywords: planting pattern, weeds, growth, yield, mustard

Introduction
Oilseed crops are the second most important determinant of agricultural economy, next only to cereals. The oil seeds are mainly used for edible oil, as animal feeds, salads, vegetables, etc. Rapeseed-mustard is world's third most edible oil, after groundnut and soybean. In 2017-18 area, production and productivity of rapeseed-mustard was 6.412 m ha, 6.33 m ton and 6979 kg/ha as given by Solvent Extractor Association (SEA) of India. Among 7 edible oilseed cultivation in India, brassica sp. accounted for approximately for 28.6% of the entire oilseed production, second largest just to groundnut, which contributes for 27.8% of India's oilseed financial sector. Madhya Pradesh produced 210 thousand tonnes or about 5% of the total production of India. Different Brassica species like *Brassica juncea*, *Brassica carinata*, *Brassica oleraceaea*, *Brassica compestris*, *Brassica nigra* predominate in different region of the world.

Planting pattern is another basic factor for obtaining high crop yield and high return. In general, farmers who intend to raise mustard can choose between two methods of planting i.e. direct planting and transplanting. The other different planting pattern like raised bed, furrow method, different type of spacing used for growing these crops.

Weed infestation is one of major threat to low productivity of field crops. Weed invasion is one of significant threat to low efficiency of field crops. Weeds compete with crop for nutrient, light, space, moisture and many allelopathic effects. According to Cheema and Khaliq, 2000 allelopathy is the direct or indirect harmful effect by one plant on another. *Chenopodium album*, *Asphodelus tenuifolinus*, *Melilotus indica*, *Cornopus didymus*, *Spergula arvensis* and *Phalaris minor* etc. cause serious yield losses in mustard. The weeds can be controlled by cultural, mechanical, biological, chemical method or integrated methods. The cultural methods are the agronomic manipulations like adjusting date of sowing, planting pattern, methods of fertilizer application, plant density, etc. The mechanical control is removing the weeds physically or with small tools or implements and in biological methods, the weeds are controlled with living organism. In chemical methods weeds are controlled with herbicides. Sometimes, use of single method is not 100% effective, so use of more than two methods is called integrated weed management. IWM is rational use of direct and indirect weed control methods to provide cost effective weed control. Coordinating these distinctive weed control strategies may upgrade mustard yield by 20-100%, other than improving quality. Environmental factor like temperature, humidity, rainfall etc. plays an important role in development of weeds. In weed competition, loss of crop yield depends upon weed population and their growth habitats. Up to 44.5% loss was reported by Kaneria and Patel 1995 whereas up to 56% by Patel *et al*. 1997 in mustard.

Reviews

1. Losses due to weeds

Rana *et al*. (2015) [16] studied critical period of crop weed competition in Brassica crops (Tab.1)

Anonymous (2011) [1], AICRP (All India coordinated research project on rapeseed-mustard) noticed that the various mustard yield losses 18.1% from Ludhiana and 41.7% from Varanasi.

Singh *et al*. (2001) [18] reported 25-45% losses due to crop weed competition depending on kind of weed vegetation and their power, stage, nature and duration for competition.

Gupta *et al*. (2000) [4] reported that seed yield reduction of mustard due to competition of different weeds viz. *Chenopodium album*, *Convolvulus arvensis* and Melilotus indica was 43.32, 40.60 and 35.26 percent respectively.

Yaduraju *et al*. (2000) revealed that the *Asphodelus tenuifolinus* were important reason of low productivity of mustard and reduce the yield to 56%.

Prusty *et al*. (1996) recorded that weed infestation during beginning phases of crop growth caused yield decrease up to a stretch out of 58% in Indian mustard.

Singh *et al*. (1995) reported that 25% seed yield was reduced by weeds due to competition for moisture and nutrients.

Singh *et al*. (1994) reported maximum yield reduction (48.36%) due to competition from *Melilotus indica* followed by *Phalaris minor*.

Tiwari and Kurchania (1993) revealed that the mustard yield reduction as high as 70% due to weed infestation.

Table 1: Critical period for weed competition in different oil seed crops

	Critical time	Yield reduction%
Rapeseed-mustard	15-40	15-30
Soybean	20-45	40-60
Groundnut	40-60	40-50
Castor	30-50	30-35
Linseed	20-45	30-40
Sesamum	15-45	15-45
Sunflower	30-45	30-60
Safflower	15-45	15-40

Source: Rana *et al*. (2015) [16]

2. Role of planting pattern on yield of mustard

Kaur *et al*. (2019) [11] outlined the maximum yield, nitrogen and protein content in seed in Ethiopian mustard at 25×15 cm spacing.

Das *et al* (2017) resulted supply of water could be conserved up to 20-40% in crops by raised bed method than furrow method in water scarcity areas.

Sims (2012) [20] examined that the sowing of oil seed rape with roller drill method increases the yield and plant population.

Pyare *et al*. (2008) reported maximum seed yield of 1851 kg/ha and stover yield of 3808 kg/ha under 45×10cm as compared to normal planting 60×15cm in mustard.

Iqbal *et al*. (2007) [7] reported that planting of single or double rows on raised bed was effective in inhibiting the purple nut sedge density (70-97%) and dry matter production (71-97%).

Punia *et al*. (2001) [14] reported the plant height and siliqua/plant were significantly higher when/ Ethiopian mustard was planted at spacing of 60×10cm, but seed yield was highest under 30×10cm spacing.

Sher *et al* (2001) reported that higher plant/m^2, plant height at harvest, pods/plant, test weight, oil content% effected by planting method (Table: 2).

Singh *et al*. (2001) [18] observed greatest seed yield (1705 and 1945 kg/ha) was recorded in weed free treatment during both yields which was composed of two manual hoeing at 25 and 45 day of sowing (1593 and 1792 kg/ha) and these treatments are more profitable than other herbicidal treatments.

Malik *et al*. (2001) [13] revealed that different row spacing 30, 45 and 60 cm and maximum yield obtained at 30 cm row spacing.

Misra *et al*. (1992) recorded that planted *Brassica napus* var. sarson in rows 30, 45 or 60 cm and reported that seed yield decreased with increase in row spacing.

Moreno *et al* (1993) viewed that plantation on raised bed performed well in conservation of natural resources viz. rain water exchange of gasses and weed competition efficiency.

Hakeem *et al*. (1996) [6] observed at more plant density resulted in declined the oil content in *Brassica compestris.*

Yadav *et al*. (1996) [25] revealed that significant effect of mulching on grain yield of oil seed mustard and on the other hand mulching material in decreased weed growth in mustard.

Saini *et al*. (1986) [5] reported that simultaneous sowing of Indian rape and oilseed rape in alternate rows at 22.5 cm row spacing resulted in 58 and 99 per cent higher oilseed rape equivalent seed yield than sole crop of oilseed rape and Indian rape.

Gupta *et al*. (1988) reported when bigger plants was observed in plot lines, where crop was planted in 60 cm column separated followed by 45×50 cm line dividing because of adequate space resulting in plants grown well & showed greater height.

Table 2: Effect of raya (*Brassica juneca L.)* planting pattern on growth and yield attributes

Planting pattern	Plant height(cm)	Pods/ plant	Test weight(g)	Seed yield t/ha	Oil content%
Two row 60/30cm	171.1	532.9	3.7	1.6	43.4
One row 30cm	176.2	402.6	3.6	1.65	43.16
Two row 40/20cm	175.3	475.7	3.9	1.66	43.2
One row 45cm	178.5	402.6	3.6	1.7	43.16
Inter spacing					
10 cm	176.4	415	3.5	1.64	43.2
15 cm	179.3	475	3.7	1.61	43.4
20 cm	173.5	530.8	3.61	1.6	43.39

Source: Sher *et al*. (2001)

Table 3: Mustard Impact of Planting method and weed management treatments

Treatments	No. of branches/ plant at harvest	No. of siliqua/ plant at harvest	No. of seed/ siliqua at harvest	Test weight (g)	Oil content (%)	Oil yield (kg/ha)
Planting pattern						
P: 30×10cm 1 Row	16.01	171.67	9.71	3.99	37.86	621
P_1: 45×10cm 1 Row	18.07	204.16	11.59	4.25	39.60	742
P_2: 30/60×10cm double row	17.40	193.64	10.85	4.11	38.83	695
C.D at 5%	1.00	13.13	0.78	NS	NS	72.52
Weed management practices						
W_1: Un weedy	13.42	132.80	8.00	3.50	34.76	348
W_2: Hand weeding + IC at 20,40 DAS	16.89	184.36	9.96	4.01	38.02	647
W_3: Pendi. @ 1.0 kg/ha as Pendi + Hand weeding + IC at 40DAS	18.42	211.18	11.93	4.35	40.21	755
C.D at 5%	1.29	16.95	1.01	0.28	2.38	93.62

Source: Jangir *et al*. (2015) [8]

3. Role of weed control on weed growth and crop yield

Kaur *et al*. (2014) [9] reported the highest seed and stover yield in mustard with 25×15cm spacing as compare to 30×15cm spacing.

Arif *et al*. (2012) [2] studied on 5, 10, 15 cm plant spacing and 10, 20, 30 row spacing in white mustard and maximum yield was obtained by increase in the number of pods/plant in 10×15 cm as well in 20×15 cm spacing.

Yadav *et al*. (2004) [26] observed that maximum yield of 17.08 q/ha with pre-development use of Pendimethaline 0.75 kg/ha along hand weeding in mustard.

Sachan *et al*. (1997) [23] examined that mulching of paddy straw noteworthy improve yield and yield properties and seed yield of mustard.

Mandal *et al*. (1991) [12] noticed that mulching with straw at 7.5t/ha increment the dry matter of mustard (*Brassica juncea*).

Mittra *et al*. (1990) concluded black polyethylene (25 micron thick) increment seed yield of mustard by 139% than that of without mulch.

Verma *et al*. (1985) observed mulching either with straw or crop residue improve the soil moisture holding capacity and decline soil temperature, less vanishing misfortunes and lessen the development of weeds.

Conclusion

It is concluded that the role of planting pattern and weed control methods are most important factor to increase the growth and yield characters. Different type of planting methods like raised bed, furrow, ridges, flat sowing improve the yield, quality of crops, weed competition, saving of water, reduce diseases and pest attack, better crop growth, proper drainage and improve soil structure. The infestation of weeds reduce the growth, quality, yield of crop and they are controlled by various weed control methods like cultural, mechanical, physical, chemical and biological. Overall, planting pattern on raised bed and IWM methods play crucial to improve the productivity, growth, quality attributes and also increase the water use efficiency moreover, chemical method is most effective method to control weeds as compare to others.

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