

Impact of Row Spacing and Weed Competition Period on Growth and Yield of Rapeseed; A Review

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ABSTRACT

Oil seed crops are very important for human food. Weeds are the most important issue of agriculture crop production. The best way to enhance the production of oilseed is to adopt the better management of weeds in crops and crop nutrition. The production of oilseed crops has not increased at the same rate as it has occurred in cereal crops. Rapeseed is very significant oilseed crop due to good amount of oil but faces severe problems and competition by weeds for nutrients and moisture, which consequently loss its potential yield under intense competition. The present review was executed with the following objectives; 1. To study the impact of row spacing and weed competition period on growth and yield of Rapeseed. 2. To evaluate the best row spacing and management strategies to control weeds and enhance production.

Keywords: Rapeseed, Oil, Row spacing, Weed competition.

INTRODUCTION

Oil seed crops are very imperative for human food and have attained the third position among the crops along cereals and legumes and are a very important source of vegetable oil which offers 2.5 times extra energy over carbohydrates and protein. It has certain vitamins E and D as well as essential fatty acids obligatory for the human body (Downey,

1990). Edible oil is one of the significant merchandises of humans in everyday usage. (Anonymous, 2017). Rapeseed is very significant oilseed crop due to 40-46% good amount of oil. Moreover, its meal has 38-40% protein which has a comprehensive quantity of amino acids together with lysine, methionine and cysteine (Amjad, 2014).

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Therefore, there is an immense need to focus on the higher production of the oil seed crops in order to conserve the valuable foreign exchange and to fulfill the indigenous requirement of the oil. The production of oilseed crops has not increased at the same rate as it has occurred in cereal crops. The foremost constraint to enhance the oil seed crop productivity is the inappropriate weed control practices. Best way to enhance the production of rapeseed is to adopt the better management of weeds in crops and crop nutrition (Singh & Verma, 1993). Rapeseed faces severe problems and competition by weeds for nutrients and moisture, which consequently loss of about 20-30% and up to 60% from the potential yield under intense competition (Singh, 1992). In rapeseed fields, weeds are the most important determinative factors. Weeds may have the somewhat allelopathic effect that competes with crop plants for factors like light, water, nutrients and, space. At early stages, mustard is a slowly growing and thereby exposed to severe competition by weeds. At initial stages, competition by weeds is a major limiting factor to its production (Singh & Kumar, 1990).

Weeds interference and their competition are one of the key factors that affect together the yield and quality of the crops (Hager et al., 2002). Moreover, weed crop competition duration is also major factor influencing quality of crop production (Asif et al., 2020). Seeding density, the orientation of row and spacing of row are of immense significance among agronomic practices, the dynamics and interference in weed-crop influencing (Matloob et al., 2015). In weed-infested situations, at early stages, narrow crop spacing and higher seed rate, eventually consequence in the enhancement of the uptake of the resources through the aggregation of biomass (Chauhan et al., 2005). Higher seed rates, altered row orientation, narrower row spacing and the competitive species selection have been estimated as encouraging IWM methods to improve the competitiveness in the crop (Khaliq et al., 2013). Narrower crop rows

and thick plant populations work rightly in repressing weeds germination and enhancing the crop yields. For the economical production of the crop, proper weed management through a different or combination of techniques is very essential to apply. Keeping in mind the above defined particulars, the present review was executed with the following objectives; 1. To study the impact of row spacing and weed competition period on growth and yield of Rapeseed. 2. To evaluate the best row spacing and management strategies to control weeds and enhance production.

1. Impact of Row Spacing on growth and yield of Rapeseed

Proper row spacing of a particular crop is a significant agricultural factor and has a lot of impacts on the yield and its various components (Diepenbrock, 2000). Many scientists reported that narrow row spacing resulted in maximum seed yield over board row spacing. Plants that grow in extensive wider rows may not effectively exploit the natural growth factors like light, water and nutrients, however, planting of crop in too much narrower rows may result in extreme inter and intra-row spacing competition (Ali et al., 1999). Thus, it is very imperative to deploy the proper spacing of row of the particular crop in order to increase plant productivity and for efficient use of natural resources. Plant population is the key factors signifying the quantity of radiation intercepted to per plant. In mustard, row spacing varies significantly across the world, subject to the cultivar, production system and prevailing environmental conditions of a particular region. Maintaining a proper row spacing is a vital factor to improve the growth of the crop and the time essential for canopy closure, alongside with the highest biomass and seed yield (Svecnjak et al., 2006 & Haddadchi & Gerivani, 2009). In rapeseed crop, narrow row spacing or higher population of plant also helpful to regulate the growth of weeds species (O'Donovan, 1994). Ozer (2003) conducted a field trial in Turkey to find out the impact of different row spacing (15cm, 30cm, 45cm) on the growth, yield and its components of

rapeseed and finds out the higher seed yield of 1195 kg/ha at narrow 15 cm row spacing of crop. Approximately 8 and 40% greater seed yield recorded than 30 and 45 cm spacing, in 15 cm row spacing on an average. The maximum number of branches per plant (5) and plant height (114.32cm) found in wider 45 cm row spacing as paralleled to narrow spacing. Morrison et al. (1990) documented that plant height increases with the increase in row spacing in rapeseed. Momoh and Zhou (2001) stated that with the increase in plant density the number of pods per branch and effective branches decreased. Waseem et al. (2014) performed a field trial at lasbela, Pakistan to check the effect of row spacing (15cm, 30cm, 60cm) on the yield and various yield components of different canola cultivars. They found the maximum plant height (105 cm), a number of pods per plant (381), seed yield (3325 kg ha⁻¹) at 60 cm row spacing. Bilgili et al. (2003) conducted a field research to examine the influence of different row spacing (17.5 cm, 35 cm, 52.5cm, 70 cm) on seed yield and yield component of *Brassica rapa* L. in Turkey. They found maximum plant height (147.3cm) and number of plants (122 m⁻²) at narrow row spacing 17.5 cm. However, they recorded the maximum number of branched per plant (8) and seed yield (1409 kg/ha) at 35 cm row spacing.

Chaniyara et al. (2002) conducted a study in India to probe the impact inter and intra row spacing on growth and yield of mustard. The inter row spacing was 45 cm, 60 cm, 75 cm. From this experiment, they recorded the highest seed yield from the narrowed row spacing. Yazdi et al. (2007) implemented a field experiment to check the impact of row spacing (12 cm, 18 cm, 24 cm) on the yield of *Brassica napus*. They recorded the maximum seed yield (3309.44kg/ha) in narrow 12 cm row spacing. Shahin and Valiollah (2009) conducted a field investigation to study the impact of different row spacing (12 cm, 18 cm, 24 cm) on the growth and yield of *Brassica napus* in Iran. They found that higher seed yields 3309.44 kg/ha at narrow 12 cm row spacing while the

maximum plant height (121.7 cm) recorded at wider 24 cm row spacing. Radjabian et al. (2009) planned and performed a trial to evaluate the effect of different row spacing (25 cm and 35 cm) and competition duration on the yield and yield components of *Brassica napus* at Rasht, Iran. They found the maximum seed yield 3504 kg/ha at narrow 25 cm row spacing. However, they recorded the seed yield of 4240 kg/ha where the conditions were weed free during the growing season while in weedy situations in the whole growth season a seed yield of 2341 kg/ha recorded.

Hasanuzzaman and Karim (2007) performed a research to know the consequence of unlike row spacing (20 cm, 30 cm and 40 cm) on the yield of rapeseed under the conditions of Bangladesh. From this experiment they found the maximum plant height 91.80 cm at narrow 20 cm row spacing while minimum 87.38cm at wider 40 cm row spacing. However, the number of branches per plant found higher in wider row spacing than narrower row spacing. 1000-seed weight also recorded higher in wider 40 cm row spacing as compare to others spacings. Moreover, they recorded the higher seed yield 1793.5 kg/ha in 30 cm row spacing while low seed yield 1502.2 kg/ha produced in 20 cm row spacing and highest harvesting index 36.20% also noted in 30 cm row spacing while minimum harvesting index 32.17% obtained in 20 cm row spacing. In rapeseed, by increasing in plant population the branches per plant reduces (Singh & Verma 1993). Siag et al. (1993) documented that the maximum plant height in 30 cm row spacing with two irrigations at the stage of branching and flowering.

Singh et al. (1989) documented that as the rise in row spacing, the number of plant/m² decreases. Rahman et al. (2010) conducted a study to explore the influence of unlike row spacing (15 cm, 30 cm and 45 cm) on the growth and yield of rapeseed at Bangladesh. From the results of this enquiry, they reported that the maximum plant height 87.11 cm at 45 cm rows spacing whereas the minimum plant height 82.99 cm found at narrow 15 cm rows spacing. Number of plants

found higher 133 at narrower rows spacing but the lowermost at broader spacing. Number of effective branches per plant recorded higher at wider 60 cm while lowest at narrow 15 row spacing. Moreover, the maximum seed yield of 1.89 t/ha was found at 45 cm row spacing while lower at broader spacing. Test seed weight also found higher at 60 cm row spacing. In Erzurum, Turkey Ozer (2003) observed that 15 cm rows spacing produce almost 8-40% greater seed yield over 30 and 45 cm. Sierts et al. (1987) conducted an investigation to identify the influence of many rows spacing (14 cm, 31 cm and 41 cm) on the yield and growth of *Brassica napus*. From the results of this investigation, they found the maximum seed yield of 26.7 t/ha at narrow 14 cm row spacing. A higher number of plants was also in 14 cm row spacing.

Shahin and Valiollah (2009) conducted a field inquiry to probe the stimulus of many rows spacing (12 cm, 18 cm and 24 cm) on the growth and yield of *Brassica napus*. From the results of this experiment, they reported the maximum plant height 121.71 cm at 24 cm row spacing while the lowest plant height found at 119.79 cm. They found the maximum seed yield 3309.44 kg/ha at narrow 12 cm row spacing while minimum 3084.84 kg/ha at 18 cm. Yazdifar and Oad (2001) documented that maximum plant height was recorded in the plots where the crop was grown in rows of 60 cm distance trailed by 45cm and 30cm row spacing. Lee and Sanderson (1998) also reported higher seed yield in 23 cm row spacing than the 35 cm row spacing. Kleeman and Gill (2010) recorded the higher seed yield in 20 cm plant spacing than the 40 cm plant spacing. Keivanrad and Zandi (2012) conducted a study the effect of numerous plant densities (80 plant m⁻², 100 plant m⁻² and 120 plant m⁻²) on the growth and yield on mustard. From this trial, they found maximum plant height (115.2 cm) at 120 plants m⁻² while the higher seed yield (2218 kg/ha) achieved at 80 plant m⁻². Morrison et al. (1990) performed an experimentation to scrutinize the outcome diverse row spacing (15 cm and 30 cm) on the yield of *Brassica napus*.

In this experiment, they find out the higher seed yield (3514.9 kg/ha) in narrow row spacing over the seed yield (2920.0 kg/ha) of wider row spacing. Oad et al. (2001) found the higher plant height, number of branches per plant, number of the pod, seed weight per plant, seed index, seed yield at 60 cm row spacing in Gobhi sarson (*Brassica napus*).

2. Impact of weed competition period on growth and yield of Rapeseed

Weed interference period is one of the vital factors that determine the magnitude of yield reduction. Interference of weed with crops is not analogous at different growth periods; thus, weed-crop competition ability is varying in the life cycle. Lessening of weed intervention and rise in weed free intervals results in proliferation of yield and yield constituents (Singh et al., 1993). It is well known that as the competition duration increases the yield of various crop decreases and vice versa. Weeds cause a significant reduction in yield extending from 15–30% to a complete disaster in mustard yield under extreme competition. The critical period for the weed crop competition is 15–40 days after sowing in mustard (Singh, 1992). Weed free conditions in the complete growing season produces 39.9% more seed yield than weedy checked in *Brassica juncea* and weed can cause maximum losses in the early 20 to 40 DAS (Bhan & Mishra, 1993). For that reason, successful management of the weeds during this stage by manual weeding at 25 to 30 DAS is sufficient. Sewak et al. (2007) executed a field study in India to recognize the impact of several weed control strategies on the growth and development of mustard. They documented the maximum seed yield seed yield of (18.56 q/ha) with hand hoeing at 30 DAS than the weedy check (12.27 q/ha.) Degra et al. (2011) conducted a field experiment at Jaipur, India to investigate the different weed management approaches in mustard in which they recorded the maximum plant height (150.6 cm) and seed yield (19.2 q/ha) with two hand hoeing's at 25 and 45 DAS over weedy check (13.40 cm) and (13.1 q/ha) correspondingly. They also find out

lowest weed density (3.35) and weed (70.5 kg/ha) with two hand weeding at 25 and 45 DAS over a weedy check (10.85) and (528.4 kg/ha) respectively. Kumar et al. (2012) performed a study at Himachal Pradesh, India to study the integrated weed management approaches in mustard in which they recorded the seed yield (1577kg/ha) and plant height (174.8 cm) in two hand clearings at 30 and 60 DAS than the un-weeded plots (830 kg/ha) and (139.3 cm). They also recorded the dry weight of weeds (18.8 g/m²) at harvest after two manual weeding at 30 and 60 DAS and nitrogen (7.83 kg/ha) and sulphur (2.13 kg/ha) uptake by weeds.

Mukherjee (2014) performed a field experiment to investigate the different weed management techniques in mustard in which he found that the weeds accumulate the dry weight (13.2 g/m²) after the two hand weeding at 25 and 50 DAS over control (62.2 g/m²). Moreover, he recorded the seed yield (2.27 t/ha) after the two hand weeding at 25 and 50 DAS than control (0.87 t/ha). Straw yield recorded after the two hand weeding at 25 and 50 DAS is (3.84 t/ha) over control (2.79 t/ha). Shaheenuzzamn et al. (2010) planned a study to evaluate the different approaches to weed controlling in mustard at Bangladesh. In this experiment they compare the weed free and no weeding treatments and found the plant height (124.7 cm), number of pods per plant (142), seed yield (1245 kg /ha), straw yield (3843 kg /ha) in weed free conditions while in weeded conditions (110 cm), (118), (1009 kg /ha), (3759 kg /ha) respectively. Angiras et al. (1990) performed an experiment to know the weed management in *Brassica napus* in Himachal Pradesh, India. In this experiment, they study the weed free and weeded circumstances and found that weed dry weight in weed free condition (110 g/m²) over weedy conditions (260.5 g/m²) in a whole crop season. Chakhaiyar and Ambasht (1990) conducted a field experiment at Uttar Pradesh, India to see the influence of various weedy and weed free duration in the mustard crop. From the investigations of the experiment, they found the weed dry weight 110.5 g/m² in

weedy conditions and 8.5 to 88.4 g/m² after 20 and 100 days' emergence of the crop respectively. Cheema et al. (2002) implemented an experiment to check the effectiveness of many weed management approaches in *Brassica napus* at Faisalabad, Pakistan. They recorded that two hand clearings at 20 and 40 DAS significantly reduce the weed dry weight 77%, weed density 67 % over the whole and maximum seed yield of 942 kg ha⁻¹.

Singh et al. (2001) planned a study to identify the weed management processes in *Brassica* species in India. They compare the different duration of weed and find out that the maximum seed yield of 1692 kg/ha in two hand weedings at 25 and 45 DAS over weed free condition 1825 kg/ha. Chauhan et al. (2005) conducted an experiment to study the weed control practices in mustard at Madhya Pradesh, India. They found that the seed yield of 17.5 q/ha after two hand weeding at 25 and 40 DAS next to the weed free conditions. Dashora et al. (1990) reported that if the weed free condition maintained throughout the growing season of the crop then 2.23 t/ha seed yield could be achieved in mustard. Yadav et al. (2004) reported that in mustard the weedy conditions throughout the growing season decrease the seed yield about 37.5%. Roshdy et al. (2008) conducted a field experiment to investigate the different weed management approaches in *Brassica napus* at Egypt. From this experiment they recorded the weed dry weight (109 g/m²) from the unweeded plots at 60 DAS and after two hand hoeing at 21 and 35 DAS the weed dry weight was (29 g/m²) at the time of 60 DAS. Similarly, they reported the seed yield from the un-weeded condition was 701 kg/ha and from two hand hoeing at 21 and 35 DAS was 1088 kg/ha. Straw yield from the un-weeded plot was 1520 kg/ha and from the two hand hoeing at 21 and 35 DAS was 1875 kg/ha.

Bhadoria and Chauhan (1995) reported that in mustard two weeding give higher seed yield of the crop. A field study planned by Singh et al. (1992b) reported the seed yield of 25.6 q/ha with weed free

conditions in the whole growing season Gogoi and Kalita (1995) reported that two hand weeding at 20 and 40 DAS results in lowest weed dry weight of 23.88 g/m² and weed control efficiency of 51.7 %. Aghaalikhani and Yaghoobi (2008) accomplished an experiment to check the outcome of innumerable row spacing on the progression and yield of *Brassica napus*. From the results of this experiment, they recorded that the critical era for the control of weed is 25 DAS with the 5% yield reduction in *Brassica napus*.

Patel et al. (2013) executed a field study on various weed controlling approaches in mustard. From the results of this experiment, they recorded the weed dry weight 579.00 kg/ ha in weedy conditions in the whole growing season. However, they recorded the supreme seed yield of 1738 kg/ha in the weed free conditions throughout the complete growth season. Chauhan et al. (2005) noted the lowest population of weed, dry weight and weed management proficiency were proofed in the weed free treatment than all other treatments except two hand weeding (25 and 40 DAS) which was found to be lower significantly. Degra et al. (2006) performed a field experiment in which they investigate the various weed control practices in mustard in India. They reported the maximum seed yield of (1925 kg/ha) and highest weed control efficiency (86.6%) in two hand weeding while maximum weed dry weight 52 g/ m² recorded at weedy conditions maintained in the whole growth season and lowest dry weight of weed 7 g/m² found in two hand weeding. Rajablarjani and Aghaalikhani (2011) conducted an experiment to identify the many Non-chemical weed management approaches in *Brassica napus* at Tehran, Iran. From this experiment, they recorded the weed dry weight of 257.7 g /m² in the weeded conditions throughout the growing season. Greater plant height of 99 cm was found in weed free conditions maintained in the whole season while the plant height 81 cm at the weedy condition in a complete season. Moreover, they found the seed yield of 3690 kg /ha in

weed free surroundings while in weedy conditions it was 761 kg/ha.

Mekki et al. (2010) accomplished a field experiment on some weed control techniques in *Brassica napus* in Egypt on newly reclaimed sandy soils. They recorded the weed dry weight 64.60 g/m² on weedy conditions in the plot throughout the growing season and at two hands weeding at 21 and 35 DAS the weed dry weight was 36.65 g/m² at the time of 60 DAS. Plant height in the weed conditions was 40.33 cm while in two hand weeding plot was 51.89 cm. Moreover, the seed yield from the weeded plots was 1.419 t/ha while under two weeding conditions was 2.266 t/ha. Sharma and Jain (2002) documented that two hands weeding at 30 and 45 DAP produce the highest plant height. Rajput et al. (1993) reported that the two hands weeding at 30 and 45 DAS results in the significant reduction of weed dry weight in mustard. Singh et al. (2001) found that weed control practices significantly decrease the intensity of weeds and dry matter accumulation two hands weeding at 25 and 45 DAS recorded the best among other treatments to reduce the dry matter accumulation and weed intensity. Sharma and Jain (2002) reported that weed control practices reduce the weed dry matter accumulation and weed population hence the weed control efficiency also increase the weed control efficiency. Chauhan et al. (2005) reported that two hand hoeing increase the seed yield and their components. Hamzei et al. (2007) finished an experiment to recognize the many weed competition duration (4 leaf stage, 8 leaf stage, stem elongation, flowering initiation and initial podding) in *Brassica napus* at Iran. From the results of this experiment, they reported the maximum biological yield of 2296.4 kg/ha in weed free conditions.

Akhter et al. (2016) planned and conducted a field experiment to investigate the different weed control strategies that effect the growth and yield of *Brassica campestris* at Bangladesh. From the results of this experiment, they reported the maximum plant height 101.94 cm in two hands weeding while

lowest 96.92 cm in weedy conditions throughout the growing season. Number of branches per plant was noted higher in two hands weeding while lowest in weeded plots. Moreover, greater seed yield of 898.50 kg/ha and test seed weight 3.14 g was recorded in two hands weeding and lowest in weedy conditions. Chauhan et al. 2005 documented that two hands weeding in rapeseed increase the pods/plant, seed and oil yield and test weight of seed. Kaur et al. (2013) conducted a study to see the effectiveness of many weed controlling approaches in Toria. From the results of this experiment, they reported that weed control efficiency was 92 % with two hand weeding at 25 and 45 DAS. The weed dry weight 0.10 t/ha in two hand weeding at time of 25 and 45 DAS while at weedy conditions throughout the growth season dry weight was 1.26 t/ha. Plant height 136.4 cm was noted in two hand weeding at 25 and 45 DAS however in weedy conditions it was 116.6 cm. Moreover, the number of branches per plant was 8 in two weeding at 25 and 45 DAS. Seed yield of 2.08 t/ha was at two hand weeding.

Chauhan et al. (2005) field experiment conducted at in Madhya Pradesh, India during the years of 1998 and 1999 and found in mustard [*Brassica juncea* (L.) that 2 hand-weedings (25 and 40 DAS) in mustard drastically lessened the density of weed, biomass weed and enhanced the yield of crop seed. Seed yield about 17.55 and 17.59 kg/ha was obtained during the years in 1998 and 1999 respectively. Singh et al. (2001) a field experiment conducted during the years in 1996 and 1997 found that at the 2 manual weeding (25 and 45 DAS) the seed yield of about 1,593 and 1,792 kg/ha. Singh (1992) reported that the primary branches, siliqua per plant, seeds per siliqua and 1000-seed weight due to hand weeding at 25 DAS significantly increase.

Rashid et al. (2007) conducted a field experiment at Dhaka, Bangladesh to classify the influence of a dissimilar weeding on the yield and its components of rapeseed. They found that plants keep weed free up to 40 DAS gave more seed yield (17.7%) as compared to

no weed control treatment. They also recorded the highest plant with a maximum number of branches per plant in two hand weedings at 25 and 40 DAS. Bhadoria and Chauhan (1995) found that dry weight of weeds 35.32 g/m² in weedy checked at 65 DAS over to 25.87-28.05 g/m² by numerous weed control treatments e.g. hand weeding at 30 DAS, weeding with wheel-hoe at 30 DAS and fluchloralin, pendimethalin, isoproturon and oxadiazon each at 0.75 kg/ha. Sharma and Chauhan (1995) documented that the two hand weeding at 30 and 45 DAS and fluchloralin at 0.75 kg/ha were next in order to weed free in reducing dry matter of weeds and density than one hand weeding at 30 DAS and pendimethalin at 0.75 kg/ha as a pre-emergence application.

Dashora et al. (1990) documented that loss of 14.6 kg N/ha due to the uncontrolled growth of weeds in the complete growing season of mustard. Kaneria and Patel (1995) found that the maximum N, P and K taken up in mustard (122.7, 43.0 and 144.9 kg NPK/ha, respectively) with weed free conditions in whole growing season followed by two hand weeding at 25 and 45 DAS in contrast to weedy check plots (51.3, 15.6 and 85.4 kg/ha, respectively). Dixit and Gautam (1996) reported the lower nutrient uptake (79.1, 12.7 and 66.7 kg N, P and K /ha) in weedy check in India.

CONCLUSION

It is concluded from the above review that in rapeseed crop, narrow row spacing or higher population of plants are the most helpful ways to regulate the growth of weed species. The critical period for the weed crop competition is 15–40 days after sowing in mustard. So, weed free conditions in the complete growing season produces 39.9% more seed yield than weedy checked in *Brassica juncea*.

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