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EFFECT OF WEED COMPETITION PERIODS ON THE GROWTH AND YIELD OF BLACK SEED (*Nigella sativa* L.)

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ABSTRACT

An investigation to determine the effect of weed competition periods on the growth and yield of black seed (kalwanji) was carried out at the Agronomic Research Area, University of Agriculture, Faisalabad during 2006-07 growing season. The treatments comprised of seven weed competition periods (no competition, competition for 40, 50, 60, 70 and 80 days after emergence and competition throughout the growing season). The experiment was laid out in RCBD (randomized complete block design) with four replications. The net plot size was 1.2 x 5m^2. The dominant weeds in the experimental area were Phalaris minor, Chenopodium album and Convolvulus arvensis. Data on desired parameters were recorded by using standard procedures. The results showed that the weed control practices increased the seed yield per hectare over weedy check by 69.41% by affecting different growth and yield components like number of plants, number of branches, number of capsules, number of seeds per capsule, 1000-seed weight and total biomass significantly by weed competition periods. All the components were decreased progressively by increasing weed competition periods in black seed.

Keywords: Weed competition period, 'Kalwanji', Black seed, *Nigella sativa,* Yield

INTRODUCTION

The black seed (*Nigella sativa* L.) locally known as 'kalwanji' belongs to the family Ranunculaceae. It is an annual spicy herb native to the Mediterranean region and is now cultivated in other parts of the world including Middle East, North Africa and Asia. The black seed is a crop of great medicinal importance particularly in Unani (Greek) medicine. Recently the seeds are also used in pharmaceutical industries. It is used in India, Pakistan, Saudi Arabia, Syria, Iran, Egypt and many other countries. The seeds are used in the preparation of traditional sweet dish composed of paste, which is sweetened with honey or syrup, in the preparation of pastry and in pickles. *Nigella* can serve a good source for balanced food as it consist

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of high protein (21%), carbohydrate (35%) and fats range from 35 to 38%. Black seed contain 15 amino acid including 9 essential amino acid (Abdel-Aal *et al.,*2001). Along with other necessary compounds, *Nigella* is also a source of minerals like calcium, iron, sodium and potassium. Most of the minerals are required in small amounts by the body hence main function of these elements is to act as essential cofactors in various enzymatic functions. The seed are used for diseases of the immune system itself e.g. allergies, TB, cancer, AIDs, etc. Black seed also helps the body further resistance against future ailments or diseases (Hussain, 1997). In Pakistan, it is grown on small scale in the NWFP, but its consumption is 200-250 tons annually (Ahmad and Ghafoor, 2004). It is imported from Bangladesh and India to fulfill domestic requirements. Black seed has good potential for higher yield but in our country yield is lower than other countries. Among various factors responsible for low yield, weed infestation is of great importance. Weeds reduce crop yield by competing for light, water and nutrients, thus not only reduce the yield but also increase cost of production. Weed interference in black seed cause 60-85% reduction in crop yield (Ahmad and Ghafoor, 2004). Different weed competition periods cause remarkable decrease in yield. The grain yield and yield components were significantly influenced by weed competition treatments. The greater the competition period, the greater was the crop loss. The critical period of weed competition ranged from 40-60 days after emergence. The grain yield losses due to unrestricted weed growth throughout the crop cycle were 25.7% (Aziz and Miah, 1999). Literature regarding weed crop competition is not available in Pakistan.

Keeping these factors in view, this experiment was conducted to study the effect of different weed competition periods on growth and yield of black seed under agro climatic condition of Faisalabad.

MATERIALS AND METHODS

The investigation regarding the effect of weed competition period on the growth and yield of black seed (kalwanji) carried out at the Agronomic Research Area, University of Agriculture, Faisalabad, during winter 2006-07. The experiment was laid out in randomized complete block design with four replications having the net plot size of 5 x 1.2 m^2. The experiment was sown on 22nd October, 2006 with single row hand drill using seed rate of 14 kg ha^{-1} in 30 cm apart rows. Plant to plant distance of 10 cm was maintained by thinning out weaker plants at an early growth stage. The fertilizer was applied at the rate of 50 kg N and 25 kg P_2O_5 ha^{-1} as urea and diammonium phosphate, respectively. Whole of the phosphorus and half of the nitrogen was applied at sowing while remaining half of the nitrogen

was top dressed with 1st irrigation. The experiment was comprised of T_1 = Weedy check (competition throughout), T_2= Weed free (no competition), T_3 = Competition for 40 Days after emergence (DAE),T_4 = Competition for 50 DAE,T_5 = Competition for 60 DAE T_6= Competition for 70 DAE, T_7= Competition for 80 DAE.

Where ever applicable, weeds were removed manually with hand hoe with the completion of prescribed competition period. Data on yield and growth parameters were recorded during the course of study.

The data collected were analyzed by using Fisher's analysis of variance technique and differences among the treatments' mean were tested at 5% probability level using least significant difference (LSD) test (Steel *et al.*, 1997).

RESULTS AND DISCUSSION

Studies to investigate the effect of weed competition period on the growth and yield of black seed (*Nigella sativa*) were carried out under field conditions. The dominant weeds in the experimental area were *Phalaris minor*, *Chenopodium album* and *Convolvulus arvensis.* Results obtained from the investigation under study along with their statistical analysis are presented and discussed below:

Weed density (m^{-2})

The data given in Table-1 indicate that weed density was significantly affected by weeds competition periods. The maximum weeds density (102.5) was obtained in weedy check which was significantly different from all other competition periods. The minimum number of weeds were recorded in weed free treatment where weeds were not allowed to compete with crop plants. Total weeds increased significantly with the increase in competition period. Weedy check showed maximum weed density because there was longer period available for weeds to germinate and weeds continued to germinate throughout the growth period. These results are in accordance with Tunio *et al.* (2004). Weed free plots showed minimum density because weeds were eradicated by repeated hand hoeing.

Plant height of *P. minor* (cm)

Plant height is a good indication of competition among plants. The data given in Table-1 indicate that the plant height of *P. minor* was significantly affected by the weed competition periods. The maximum (101.3 cm) plant height of *P. minor* was recorded in weedy check plots which were significantly different from all other treatments. The significantly minimum plant height of *P. minor* was noted in the weed free treatment. The linear increase in the plant height of *P. minor* with the increase of weed competition periods might be due to more period available for growth and more use of nutrients and environmental resources. Further higher density with longer

competition period might also be due to increased competition among *P. minor* plants. Furthermore the growth habit of *P. minor* is totally different from black seed *P. minor* suppressed the growth of crop by more depletion of resources.

Dry weight of weeds (g m^{-2})

The data regarding the dry weight of weeds presented in Table-1 show that dry weight of weeds was significantly affected by different weed competition periods. The significantly maximum dry weight of weeds (240.3 g) was recorded in weedy check. The minimum weeds dry weight was recorded in weed free plots. Weeds dry weight showed an increasing trend as the competition period was prolonged. The 60, 70 and 80 days competition periods were statistically similar. However, weed dry weight increased as the competition period was increased. Maximum dry weight of weeds in weedy check might have been due to higher weed density (Table-1) and longer growth period resulting in more accumulation of photosynthates and greater biomass. Although, total number of weed in 80 DAE was significantly higher than 70 DAE but the total weed dry weight showed a decline in competition period of 80 DAE, probably due to prolonged period of interspecific and intraspecific competition. The density of *P. minor* was lower and density of *C. arvensis* was higher in competition period of 80 DAE. As *C. arvensis* produce lesser dry weight per plant compared with *P. minor*. Hence, the total weed dry weight of weeds showed a decline. Same results were noticed in wheat crop by Akhtar *et al.,* (2000).

Table-1. Effect of different weed competition periods on different weed parameters in black seed *(Nigella sativa).*

Competition (DAE†)	Weed density m^{-2}	*Phalaris minor* height (cm)	Weed Dry wt.(g m^{-2})
Weedy check	102.5a[3]	101.3a	240.3a
Weed free	0.00 g	0.00g	0.00e
40	70.94 f	70.00f	146.8d
50	86.00 e	74.88e	160.3cd
60	88.81 d	79.50d	178.8bc
70	91.38 c	88.00c	193.8b
80	95.94 b	98.13b	190.5b
$LSD_{0.05}$	1.891	1.923	29.5

† DAE= Days after emergence

Plant height of black seed at harvest (cm)

The data given in Table-2 indicate that plant height was significantly affected by competition periods. These results are in

[3] Means sharing the means in common in the respective category do not differ significantly by the LSD Test at P≤0.05.

agreement with Shafaat (1982). The maximum plant height (80.75 cm) was recorded in weed free treatment where there was no competition (Weed Free). This was statistically at par with the competition period of 40, 50 and 60 days after emergence. The minimum plant height (62.00 cm) was observed in weedy check where weeds compete throughout the growth period and it was statistically similar with the competition period of 70 and 80 DAE.

Maximum plant height in weed free might be due to the reason that weeds were not allowed to compete with crop for nutrients and other resources. In competition periods of 40, 50 and 60 days weeds were not fully established and there was less competition. Due to this reason these competition periods were at par with the weed free treatment.

The minimum plant height in weedy check might be due to higher weed density causing more depletion of nutrients and moisture. Further the *P. minor* attained greater height and caused shading effect on the crop plants (Table-2). The competition period of 70 and 80 DAE showed statistically similar behavior as weedy check because after 70 and 80 days weeds had covered the crop by their canopy and their roots system as well.

Number of Black Seed plants at harvest (m^{-2})

Number of plants greatly affects the yield of black seed, the data regarding the number of plants per unit area as shown in Table-2, revealed that competition periods affected the number of plants per unit area significantly. The weed free treatment showed maximum number of plants m^{-2} (32.00) which was statistically similar to number of plants m^{-2} with competition periods 40, 50 and 60 DAE. The minimum number of plants m^{-2} (28.00) were obtained in weedy check. The decrease in number of crop plants with the increase in weed competition period might be due to suppressive and shading effect of weeds especially *P. minor* (Table-2) which attained greater height at longer competition period resulting in mortality of weaker crop plants. These results are similar as reported by Shafqat (1982). The results are however different from those of Das and Yaduraju (1999), who reported non-significant effect of weed competition period on the plant density in wheat. This difference can be attributed to difference in crop growth habit, and types of weeds species present in the either field.

Number of branches $plant^{-1}$

Data on number of branches per plant presented in Table-2 indicated significant affect of weed competition period on number of branches per plant. In black seed, weed free treatment showed maximum number of branches per plant (8.00) which were statistically the same to the competition period of 40, 50 and 60 DAE. The minimum number of branches per plant (4.75) were obtained in weedy

check. This was at par with weeds competition of 80 DAE. Absence of weeds or their short time presence in weed free and 40, 50 and 60 DAE competition might had enabled the crop to make best use of growth factors and produced more number of branches. However, there was decreasing trend among the treatments as competition period increased. While the weeds competing with black seed for 80 DAE or full season got maximum chance to utilize environmental resources at the cost of crop and ultimately resulting in lesser number of branches per plant. Moreover, less availability of space due to higher weeds density might also have resulted in lower number of branches. These results are in line with Chopra, 2003.

Number of capsules plant^{-1}

The data regarding the number of capsules per plant as shown as presented in Table-2 show that competition periods significantly affect number of capsules per plant. The maximum number of capsules per plant (35.75) were obtained from weed free treatment which was statistically at par with the competition period of 40 days after emergence. The capsules decrease with increased competition period and the minimum number of capsules per plant (20.00) were observed in weedy check which was statistically at par with the competition period of 80 DAE. The linear decrease in number of capsules per plant with the increase in weed competition period might be due to lesser number of branches (Table-2) and plant height which reduced photosynthetic apparatus. Weed competition periods of 60, 70 and 80 days after emergence were statistically same because number of branches per plant in competition periods of 70 and 80 days were also statistically same (Table-2).

Number of seeds capsule^{-1}

Number of seeds per capsule had direct relation with seed yield. The data pertaining to number of seeds per capsule of black seed as presented in Table-2 revealed that weed competition periods had significant effect on number of seeds per capsule. As regards competition periods, the maximum number of seeds per capsule (94.75) were obtained in weed free treatment which was at par with competition period of 40 DAE and statistically different from all other treatments. The minimum number of seeds per capsule (60.50) were obtained in weedy check treatment where there was weed competition throughout the crop life. The maximum number of seeds per capsule in weed free treatment might be due to the reason that weeds were not allowed to compete with the crop for nutrients and other environmental resources. Weed competition periods for 40, 50 and 60 days after emergence are statistically the same. This might be due to the fact that number of branches per plant (Table-2) were statistically similar with one other in these treatments. The minimum number of

seeds per capsules (60.50) were recorded in weedy check perhaps due to higher weed density causing more depletion of nutrients which resulted less photosynthesis ultimately number of seeds per capsule were affected. Further suppressed growth of plants and retarded development due to shading effect of weeds (Table-2) also resulted in lower number of seeds.

Table-3. Effect of different weed competition periods on 1000-seed weight (g), Biological yield (kg ha^{-1}), Seed yield (kg ha^{-1}) , Harvest index (%) and Oil content (%)of black seed *(Nigella sativa).*

Competition (DAE†)	1000-seed wt. (g)	Biol. yield (kg ha^{-1})	Seed yield (kg ha^{-1})	H. index (%)	Oil content (%)
Weedy check	1.80e	3850.0f	526.2g	13.66f	20.75f
Weed free	2.30a	6350.0a	1720.0a	27.08a	34.50a
40	2.15b	6020.0b	1607.0b	26.69a	33.75a
50	2.10b	5950.0b	1490.0c	25.04b	32.00b
60	2.07bc	5750.0c	1283.0d	22.31c	29.75c
70	1.99cd	5385.0d	955.0e	17.73d	27.50d
80	1.90d	4725.0e	745.0f	15.77e	25.25e
$LSD_{0.05}$	0.094	109.3	32.58	0.721	0.907

† DAE= Days after emergence

1000-seed weight (g)

The data on 1000-seed weight were analyzed statistically and are presented in Table-3. The data exhibit that 1000-seed weight was significantly affected by different competition periods. These results are in line with Akhtar *et al.(*1997). The trend of results shows that the maximum 1000-seed (23.09) was obtained in weed free treatment which was significantly different from all other treatments. The significantly minimum 1000-seed weight (1.80g) was obtained in weedy check plots. The competition periods of 40, 50 and 60 days after emergence are statistically similar. The maximum 1000-seed weight in weed free treatment might be due to the reason that plots were kept weed free resulted in better plant growth of black seed and more photosynthates were produced thus there was increased 1000-seed weight. The minimum 1000-seed weight in weedy check might be due to higher weed density causing more depletion of nutrients and moisture as a result of lesser photosynthates produced ultimately gave less 1000-seed weight. 1000-seed weight of competition periods 40, 50 and 60 DAE was at par with one another, might be due to the reason that their number of seeds per capsule (Table-3) were also statistically the same.

Biological yield (kg ha^{-1})

The data given in Table-3 revealed that total biomass production per hectare was affected significantly by weed competition periods. The maximum biomass of 6350.00 kg ha^{-1} in weed free plots

was significantly different from all other treatments. The difference between competition for 40 and 50 DAE were non significant. Further increase in competition period decreased the biological yield of black seed significantly. The significantly minimum biomass of 3850.00 kg ha^{-1} was recorded in the treatment where there was competition throughout. More biomass in weed free plots was obtained due to more number of branches, number of seeds per capsule and heavier seeds (Table-3). The minimum biomass weight in weedy check might be due to higher weed density (Table-3) resulting in suppressed plant growth, and lower plant height and weaker plants. These findings are similar with that of Sarandon, *et al.*(2002) who reported lesser biological yield with prolonged competition.

Seed yield (kg ha^{-1})

Seed yield was also significantly affected by weed infestation periods as is shown in Table-3. The maximum seed yield (1720.0 kg ha^{-1}) was obtained in the plots which were kept weed free throughout the growing season. Increase in competition period decreased the seed yield significantly. The significantly minimum seed yield (526.2 kg ha^{-1}) was observed in weedy check plots. The decrease in seed yield with increased competition periods was due to decrease in the main component of seed yield like number of branches per plant, number of capsules per plant, number of seeds per capsule and 1000-seed weight (Table-3). The reduction in the yield was also reported by Ahmad and Shaikh (2003) in wheat crop.

Harvest index (%)

The production efficiency of a crop at variable agronomic practices is also measured in terms of harvest index. The data on biological and economic yield was calculated for each treatment. Harvest index values as given in Table-3 indicated that weed competition periods significantly affect the harvest index of black seed crop. These results are same as reported by Lintell-Smith *et al.* (1992).The maximum harvest index (27.08%) was recorded in weed free treatment which was at par with the competition period of 40 days after emergence. The significantly minimum harvest index (13.66%) was observed in weedy check plots. The progressive decrease in harvest index with increasing competition periods might be due to the decrease between ratios of economic yield to the biological yield of black seed crop. Harvest index of weed free treatment and competition period of 40 days after emergence were statically the same, however there was a visible numerical difference in the harvest index of these treatments.

Oil contents (%)

Black seed has a value in medicinal plants because its oil is used in preparation of medicines. The data regarding the oil contents

indicated in Table-3 show that there was significant effect of weed competition periods on oil contents of black seed. The maximum (34.50%) oil contents were observed in weed free treatment. This was statistically same with the competition period of 40 days after emergence. The oil contents of black seed thereafter decreased significantly with each increment of weed competition period. The significantly minimum (20.75%) oil contents were noted in the weedy check treatment. The linear decline in the oil contents of black seed might be due to the fact that weeds compete for nutrients and environmental resources with the crop plant. Thus there was suppression of crop plants resulting in lesser photosynthates in seed ultimately the oil contents were adversely affected.

Table-3. Effect of different weed competition periods on 1000-seed weight (g), Biological yield (kg ha^{-1}), Seed yield (kg ha^{-1}), Harvest index (%) and Oil content (%) of black seed *(Nigella sativa).*

Competition (DAE†)	1000-seed wt. (g)	Biol. yield (kg ha^{-1})	Seed yield (kg ha^{-1})	H. index (%)	Oil content (%)
Weedy check	1.80e	3850.0f	526.2g	13.66f	20.75f
Weed free	2.30a	6350.0a	1720.0a	27.08a	34.50a
40	2.15b	6020.0b	1607.0b	26.69a	33.75a
50	2.10b	5950.0b	1490.0c	25.04b	32.00b
60	2.07bc	5750.0c	1283.0d	22.31c	29.75c
70	1.99cd	5385.0d	955.0e	17.73d	27.50d
80	1.90d	4725.0e	745.0f	15.77e	25.25e
$LSD_{0.05}$	0.094	109.3	32.58	0.721	0.907

† DAE= Days after emergence

CONCLUSIONS

The weed control practices increased the seed yield per hectare over weedy check by 69.41%.The seed yield decreased progressively with increasing weed competition interval by affecting different growth and yield components like number of plants, number of branches, number of capsules, number of seeds per capsule, 1000-seed weight and the total biomass.

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