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Response of various Canola genotypes to different fertility Levels under irrigated conditions of Dera Ismail Khan, KP Pakistan

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An experiment was conducted to check the influence of various fertilizer combinations on canola varieties at Agronomic research area of Gomal University, Dera Ismail Khan, Pakistan. Randomized complete block design with split plot arrangement, having three replications was used for study. PARC canola (hybrid) and Faisal canola (open pollinated) cultivars were kept in in main plots, whereas various fertilizers NPK (120:60:60 kg ha-1). Rustamorgano (125 kg ha-1), Bio care (125 kg ha-1), H R care (125 kg ha-1), Ferti source (125 kg ha-1), NPK + Rustamorgano, NPK + Bio care, NPK + R care, NPK + Ferti source, control (no fertilizer used)) were assigned to sub-plots. The yield and yield components of canola were significantly affected by using different fertilizers and varieties. The maximum siliqua length (12.00 cm), number of capsule per plant (439.00), 1000 grain weight (5.26 g), and grain yield (3547 kg ha-1) was recorded in PARC hybrid canola along with NPK applied @ 120:60:60 kg ha-1 .However, use of Ferti source +half NPK along with PARC hybrid canola was the second best yielding (2876 kg ha-1). As far as the net return is concerned, highest amount (Rs.120439/-) was earned in NPK @ 120:60:60 kg ha-1 with PARC Canola hybrid with benefit cost ratio.

Keywords: Canola genotypes, fertility levels, organic vs inorganic

INTRODUCTION

Pakistan is one of those countries facing deficiencies of edible oil production (Aslam et al. 1996). Here Significant edible oil crops are cotton seed, rapeseed & mustard, Canola Maize and sunflower respectively. Most of the oil requirements met through import, expending huge amount of foreign exchange. Locally oil consumption, contribution is 31% while 69% is being fulfilled by importing outside the country other than the use of canola oil for edible purposes , Its cakes is highly nutritious food for milks Cattles(cows &buffaloes) become of upto 40% proteins (Bazzaz et al, 2020). Canola is soil fertility &moisture sensitive crop (Islam et al. 2019).It can grow very well Canola grow very well in autumn after the harvest of summer cereals crops (Depart et al. 2017) Economy of Pakistan demands that yield of edible oil might be boosted to save foreign exchange.

In Pakistan nutrient deficiency in soil is major limiting factor demising farmer's productivity (Rashid, 1996). Nitrogen, Phosphorus, Potassium in soil is most important major plant food nutrient and its deficiency also decreases the yield (Shah et al. 2003). Nitrogen is an integral part of proteins, chlorophyll, amino acids, chromosomes and enzymes. Its application significantly increased yield and yield component of canola (Cheema et al. 2010;Malidarreh, 2010).These nutrients (NPK) Playsan imperative role in maximizing crop yield (Massignam, 2009) and quality as well in crop cultivation (Dreccer et al. 2000 and Ullah et al. 2010).

The deficiency of phosphorus reduces the yield of crop up to10-15% (Gill et al. 2004). The soil with potassium deficiency causes yield reduction and lowers nitrogen and phosphorus responses.

Biofertilizers also improve the soil structure and increase the crop yield. These manures increase leaf area, improve grain filling, intercept maximum solar radiation and enhance dry matter formation of arable crops (Wu et al. 2005). Mubassara et al. (2008) also reported increase in quantitative and qualitative attributes of crops by using bio fertilizers.

Therefore, balance use of organic and inorganic manures, their time of application and cultivars contribute significantly to crop yield. Production of crops is dependent on amount, kind and time of fertilization. The

efficacy of different Bio fertilizer synthetic fertilizer in different combinations &association among the grain yield& yield contributing parameters of canola varities as affected by organic and inorganic fertilization

Keeping in view the importance of organic and in organic fertilizers and varieties (hybrid and open pollinated) on yield of canola, trial was conducted in research area of Gomal University, D. I. Khan, KP, and Pakistan.

MATERIALS AND METHODS

The study was conducted at Agronomic Research Farm, Faculty of Agriculture, Gomal University, D.I.Khan during 2016-17. The experiment was laid out in randomized complete block design with split plot arrangement having three replications. The canola (open pollinated and hybrid) cultivars were kept in main plots and different combination of organic and in organic fertilizers were arranged in sub plots. The net plot size was 9m2with six rows of 5 m length in each treatment. The land was ploughed (3-4) times. Seed rate was applied at 5 kg ha-1 by keeping row to row distance of 30cm and 20cm distance between plants. Sowing was done in October with hand drill. Weeds were controlled manually. Irrigation was applied in all critical growth stages to fulfill water requirement of the crop. Treasure (EmamectinBenzoat) and Tryka (Imidacloprid @ 250gkg-1) were applied for insect control. Standard procedures were used to observe Agronomic and Morphological traits. The soil porosity (%) was 47.14 Bulk density 1.18(gc-3) , Highly alkaline clay soil having characteristics , Where PH was 8.01 with organic matter 0.56 (%), Electric conductivity 1481.7(uscm-1).

Detail of the experimental treatments is given below;

Main plots (Varieties)

V1 =PARC Canola (hybrid)

V2 =Faisal Canola (open pollinated)

Sub plot (Fertilizer combinations)

F1= NPK @ 120-60-60 kgha-1

F2= RustamOrgano @125 kgha-1

F3= Bio Care @125 kgha-1

F4= H R Care @125 kgha-1

F5= Ferti Source @125 kgha-1

F6= NPK (60-30-30 kg ha-1)+ Rustamorgano (62.5 kg ha-1)

F7= NPK (60-30-30 kg ha-1)+ Bio Care (62.5 kg ha-1)

F8= NPK (60-30-30 kg ha-1)+ H R Care (62.5 kg ha-1)

F9= NPK (60-30-30 kg ha-1)+ Ferti Source(62.5 kg ha-1)

F10= Control (no fertilizer)

Soil Nutrients Status of Experimental Farms.

RESULTS AND DISCUSSION

Plant height (cm)

Data presented in Table 1 indicated significant outcome for canola cultivars, fertilizers and their interaction. The hybrid PARC Canola produced taller plants of (121.50 cm) as compared to (107.87cm) in open pollinated cultivar Faisal Canola. The maximum plant height (131.17 cm) was measured in (120:60:60 NPK kgha-1) while short statured plants of (96.25 cm) were produced in control treatment. The interaction of F1 (NPK 120:60:60 kgha-1) and hybrid PARC Canola produced tallest plants of 138.00 cm height followed by 134.00 cm in hybrid PARC Canola along with F9 (50% Ferti Source + 50 % NPK). The control x Faisal Canola interaction gave short statured plants of 93.51 cm.Tallnessof hybrid could be due to its superior genetic make-up.Inayaturrehman et al ., (2009) explained that hybrid verities are tall and better than open pollinated cultivars in some other traits including yield. More over khan et al. (2008) calculated correlation between plant height and days to maturity and yield. They found positive and significant correlation of tallness with yield contributing factors. Our results are supported by the findings of Sohu et al. (2015), Muhammad et al. (2014), Song et al. (2000), Jamil et al. (2004), and Iqtidar et al. (2006) whose results proved the superiority of inorganic nutrients over organic nutrients. While Bazzaz et al. (2020) observed significant variation in plant tallness in three canola verities.

Number of capsule (plant-1)

Number of capsule per plant is important contributing factor which affected the final yield in canola. Data presented in Table-1showed significant outcome for canola cultivars, Different fertilizers and their interaction. Data analysis showed that maximum number of capsule (350.93 plant-1) were produced by F1 (NPK 120:60:60 kgha-1) and minimum number of capsule per plant (119.50) were counted in control. On the other hand PARC hybrid Canola had the maximum number of capsule (271.24) whereas minimum (191.87 plant-1) were produced by Faisal Canola. The interaction of F1 (NPK @ 120:60:60 kgha-1 x hybrid canola) gave maximum number of capsule per plant (404.17), while minimum number of capsule (104.00 plant-1) were produced in the interaction of F1 (NPK @ 120:60:60 kgha-1 x control) treatments. The difference in the obtained values might be attributed to the difference in genetic makeup of cultivar and higher capacity of hybrids towards nutrient up take and their utilization. The results favoring to our findings were reported by Khan et al. (2002); Chauhan et al. (1995); Arthamwar et al. (1996) and Cheema (1999)whose recommendations proved that combine use of NPK application increased number of silique per plant over zero NPK application. Khan et al. (2008) declared positive and significant co relation among number of capsule per plant and grain yield in canola.

Silique length (cm)

Data regarding silique length in Table-1 exposed significant results for canola cultivars and fertilizers (120:60:60 NPK kgha-1) and their interaction. The application of inorganic fertilizers (120:60:60 NPK kgha-1) produced maximum capsule length (11.1cm) while minimum capsule length for the same was recorded in control (7.65cm). PARC hybrid Canola had more capsule length (9.84cm) than open pollinated Faisal Canola (8.77cm). The interaction of hybrid PARC Canola and F1 (NPK 120:60:60 kgha-1) gave the longest capsule of 12 cm, trailed by (11.20 cm) in F9. However, minimal capsule length of (7.1 cm) was noted in Faisal Canola and control treatment. This might be due to the fact that hybrid PARC Canola efficiently utilized the applied NPK fertilizers resulting in larger capsule length. Alamsarkar et al. (2007),Ogbonna and Umar-Shaaba (2011), Jouyban and Moosave (2011)also reported similar results to our findings by concluding that NPK fertilizers enhanced the capsule length of canola.

Number of grains (silique-1)

The results (Table -1) showed significant results for canola cultivars, fertilizers and theirinteraction. The analyzed data illustrated that maximum number of grains per silique (26.78) were recorded in F1 (NPK 120:60:60 kgha-1), whereas minimum (8.59) were noted in F10 (Control). Moreover, hybrid PARC Canola remained ahead to Faisal Canola (open pollinated) by producing maximum number of grains (19.10) as compared to (13.62). The interaction between the cultivars and fertilizers also remained significant. The highest number of grains (30.17) was obtained in F1in combination with hybrid PARC Canola interaction, followed by (27.42) number of grains in hybrid PARC Canola and F9 interaction. However minimum (6.45) number of grains were counted in treatment combination of F10 (Control) with Faisal Canola. The difference of number of grains may be due to diverse genetic nature of two mentioned varieties. In addition, maximum number of grains in F1 (NPK 120:60:60 kgha-1) might be due to sufficient supply of inorganic manures. Fertilizer especially nitrogen supply incorporation enabled the crop to faster the leaf growth, maximum reception of solar radiation and resultantly maximum pod filling and ultimately maximum grains in silique.Our results are duly supported by Qayyum et al. (1999), Sultana et al. (2007),Shahzad (2003) and Bajpai et al. (1992) whose numbers of grain increased by using NPK fertilizer and in hybrid cultivars. Moreover they reported that inorganic manures are more efficient then organic manures Khan et al. (2008) reported positive but significant co relation among silique and number of grains. Sultana et al. (2007) found enhancement in increase in number of grains by NPK management.

1000 grains weight (g)

The weight grain of the crop is ultimate indicator of increase in grain yield. Data analysis of 1000 grain weight (Table-2) verified significant results for canola cultivars and fertilizers as well as their interaction. It was revealed from the obtained data that heavier seeds (4.80 g) were produced by F1(NPK 120:60:60 kg ha-1) as in contrast to lighter seed (2.88 g) produced by control. Maximum 1000 grain weight (4.19 g) was recorded in hybrid PARC Canola followed by 3.06 g in Faisal Canola. 1000-grain weight is a genetically controlled parameter; therefore, heavier grain weight in hybrid cultivar might be due to genetic makeup of that hybrid. The interactive mechanism indicated superiority of F1 (NPK 120:60:60 kgha-1) by gaining maximum 1000 grain weight (5.26g) followed by 4.93g in F9. The heavy seed weight in F1 might be due to appropriate and timely supply of nutrients and assimilation to crop as compared to control treatment. In zero fertilizer and Faisal Canola, minimum 1000 grain weight (2.49 g) was recorded. Sultana et al. (2007) reported significant increase in 1000 grain weight by increasing potassium at time of sowing. Similar results were observed by Wahid (2003) in canola who found heavier seeds in treatments where NPK fertilizers were used. Moreover, positive influence of nitrogen fertilizer on seed weight was also conveyed by (Mansoori et al. 2012 and Namvar et al. 2013). Farooq et al. (2015) calculated negative but no significant correlation between seeds in capsule, and 1000 seed weight. This condition described that by increase in number of seeds in capsule will reduce 1000 grains weight slightly in canola crop butdue to management of nutrients in the soil results may be significant in this case.

Biological yield (kgha-1)

Data on biological yield of canola showed the significant results for both the factors under study along with their interaction. The maximum bio mass yield (1183 kgha-1) was recorded in F1 (NPK 120:60:60 kgha-1), while minimum value in this respect was depicted in F10 (Control).In main plots Hybrid PARC Canola out yielded in biological yield (10398 kgha-1) to open pollinated Faisal Canola (8859 kgha-1).

Table 1: Morphological traits of Canola genotypes under different fertility levels.

		F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	Mean
Plant height	PARC canola	138.00 a	112.67 j	115.00 i	115.00 i	120.00 fg	122.87 ef	126.00 d	129.67 c	134.00 b	99.00 m	121.50 a
	Faisal canola	124.0 de	91.0 o	99.0 m	104.5 l	108.5 k	109.7 k	112.5 j	117.0 hi	119.0 gh	93.5 n	107.87 b
	Mean	131.17 a	101.83 i	107.00 h	111.28 g	114.25 f	116.17 e	119.25 d	123.33 c	126.50 b	96.25 j	
No of capsule\ plant	PARC canola	404.17 a	166.07 lm	196.67 kl	231.20 lj	258.50 gh	285.87 ef	318.13 d	341.80 c	375.00 b	135.00 nop	271.24 a
	Faisal canola	297.70 de	120.73 op	138.20 mno	154.13 mn	176.80 l	198.53 jkl	218.53 jk	241.17 hi	268.93 fg	104.00 p	191.87 b
	Mean	350.93 a	143.40 i	167.43 h	192.67 g	217.65 f	242.20 e	268.33 d	291.48 c	321.97 b	119.50 j	
Silique Length	PARC canola	12.00 a	8.70 hij	8.90 f-i	9.30 efg	9.50 ef	9.80 de	10.20 cd	10.60 c	11.20 b	8.20 j	9.84 a
	Faisal canola	10.200 cd	7.40 k	8.20 j	8.50 ij	8.70 g-j	9.20 e-h	9.50 ef	9.70 de	9.20 e-h	7.10 k	8.77 b
	Mean	11.10 a	8.05 g	8.55 f	8.90 ef	9.10 de	9.50 cd	9.85 bc	10.15 b	10.20 b	7.65 g	
No of grain per capsule	PARC canola	30.17 a	10.96 lmn	12.60 kl	14.84 ij	17.27 gh	19.79 f	22.52 de	24.81 c	27.42 b	10.65 mno	19.10 a
	Faisal canola	23.38 cd	8.06 qr	8.82 pq	10.04 nop	11.80 klm	13.13 jk	15.70 hi	17.90 g	20.85 ef	6.54 r	13.62 b
	Mean	26.78 a	9.51 hi	10.71 h	12.44 g	14.53 f	16.46 e	19.11 d	21.36 c	24.14 b	8.59 i	

Table 2: Economics traits of Canola genotypes under different fertility levels.

		F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	Mean
1000 grain weight	PARC canola	5.26 a	3.39 hi	3.66 gh	3.87 fg	4.08 ef	4.34 de	4.55 cd	4.77 bc	4.93 b	3.04 jk	4.19 a
	Faisal canola	4.34 de	2.37 m	2.53m	2.64 lm	2.86 lm	3.04 jk	3.18 ij	3.37 hi	3.73 g	2.49 m	3.06 b
	Mean	4.80 a	2.88 hi	3.09 gh	3.26 fg	3.47 ef	3.69 de	3.87 cd	4.07 c	4.33 b	2.77 i	
Biological yield	PARC canola	13129 a	9267 ij	9736 gh	9959 fg	10174 ef	10426 de	10683 cd	10941 bc	11200 b	7967 o	10348 a
	Faisal canola	10533 de	7867 o	8259 mn	8530 lm	8807 kl	9063 jk	9285 ij	9522 hi	9727 gh	7000 p	8859 b
	Mean	11831 a	7483 i	8998 g	9245 fg	9491 ef	9744 de	9984 cd	10232 bc	10463 b	7483 i	
Grain yield hg\ha	PARC canola	3547 a	1473 lm	1659 ij	1860 gh	2165 f	2310 ef	2524 d	2714 c	2876 b	1201 mn	2233 a
	Faisal canola	2366 de	828 p	1055 o	1196 no	1336 mn	1496 kl	1640 jk	1774 hi	1940 g	583 q	1422 b
	Mean	2957 a	1151 i	1357 h	1528 g	1751 f	1904 e	2082 d	2244 c	2408 b	892 j	
harvest Index	PARC canola	26.96 a	15.88 j	17.02 i	18.67 h	21.26 f	22.15 e	23.62 d	24.80 c	25.67 b	15.04 k	21.11 a
	Faisal canola	22.43 e	10.48 n	12.69 m	13.90 l	15.04 k	16.38 j	17.53 i	18.51 h	19.88 g	8.27 o	15.51 b
	Mean	24.69 a	13.18 i	14.85 h	16.28 g	18.15 f	19.26 e	20.58 d	21.65 c	22.77 b	11.65 j	

Table 3: Benefit cost ratio/ Net return of canola genotypes as affected by different fertilizer levels

Treatments		Grain yield (kg ha^{-1})	Cost (Rs.)			Total Income (Rs.)	Net Income/ Return (Rs.) BCR	
Varieties	Fertilizers Doses		Fixed	Variable	Total			
PARC Canola Hybrid	F_1 NPK 120:60:60 kg ha^{-1}	3548	29161	27800	56961	177400	120439	3.11
	F_2 RustamOrgano 125 kg ha^{-1}	1473	29161	5500	34661	73650	38989	2.12
	F_3 Bio Care 125 kg ha^{-1}	1659	29161	6250	35411	82950	47539	2.34
	F_4 H R Care 125 kg ha^{-1}	1860	29161	6125	35286	93000	57714	2.64
	F_5 Ferti Source 125 kg ha^{-1}	2165	29161	6875	36036	108250	72214	3.00
	F_6 NPK(60:30:30) + RustamOrgano (62.5)	2311	29161	15150	44311	115550	71239	2.61
	F_7 NPK(60:30:30) + Bio Care (62.5)	2524	29161	15525	44686	126200	81514	2.82
	F_8 NPK (60:30:30 kg) + H R Care (62.5)	1715	29161	15463	44624	135750	91126	3.04
	F_9 NPK(60:30:30) + Ferti Source (62.5)	2876	29161	15838	44999	143800	98801	3.19
	F_{10} Control (no fertilizer)	1201	29161	2500	31661	60050	28389	1.89
Faisal Canola Open Pollinated	F_1 NPK 120:60:60 kg ha^{-1}	2367	29161	20100	49261	118350	69089	2.40
	F_2 RustamOrgano 125 kg ha^{-1}	829	29161	3300	32461	41450	8989	1.28
	F_3 Bio Care125 kg ha^{-1}	1055	29161	4050	33211	52750	19539	1.59
	F_4 H R Care125 kg ha^{-1}	1196	29161	3925	33086	59800	26714	1.81
	F_5 Ferti Source125 kg ha^{-1}	1337	29161	4675	33836	66850	33014	1.98
	F_6 NPK(60:30:30) + RustamOrgano (62.5)	1496	29161	12950	42111	74800	32689	1.78
	F_7 NPK(60:30:30) + Bio Care (62.5)	1640	29161	13325	42486	82000	39514	1.93
	F_8 NPK (60:30:30 kg) + H R Care (62.5)	1774	29161	13263	42424	88700	46276	2.09
	F_9 NPK(60:30:30) + Ferti Source (62.5)	1940	29161	13638	42799	97000	54201	2.27
	F_{10} Control (no fertilizer)	583	29161	300	29461	29150	-311	0.98

In the interaction, maximum biological yield (13129 kgha-1) was obtained from F1 (NPK 120:60:60 kgha-1) and hybrid PARC Canola followed by (11200 kgha-1)in combination of PARC hybridand F10.These results could be attributed to the difference in morphological structure of hybrid and open pollinated cultivars which produced greater biomass in combination with NPK fertilizer which made possible sufficient supply of nutrients to canola. The minimum biological yield (7000 kgha-1) were obtained in F10 (control) x Faisal Canola interaction .Misras(2003) reported that NPK gave maximum biological yield in Brassica species. Bazzaz et al. (2020) concluded that varieties of canola have difference in canopy, which ultimale result into difference in their biological yield.

Grain yield (kgha-1)

Grain yield data (Table-2) indicated significant variations by using canola cultivars and various fertilizer doses. The highest grain yield (2459 kgha-1) was attained in F1 (NPK 120:60:60 kgha-1), whereas minimum yield (892 kgha-1) was found in control treatment. The hybrid PARC Canola gave maximum (1201 kgha-1) grain yield but minimum grain yield was taken form Faisal canola (open pollinated).The interaction of hybrid PARC Canola and NPK @ 120:60:60 kgha-1produced highest (3547 kgha-1) grain yield, the next highest yield (2876 kgha-1) was recorded in the interaction of hybrid PARC Canola and (Ferti Source + NPK). The least grain yield was obtained in zero fertilizer x Faisal Canola combination. This increase in yield in canola might be due to increase in yield components of canola e.g., number of silique, 1000-grain weight and number of grains per silique. These result are supported by (Riedell et al. 2000), Gammellvind et al. (1996) and Hocking et al. (1997)who declared that NPK fertilizers boost crop yield significantly. Farooq et al. (2015) showed grain in capsule and single plant grain yield having correlation negative and non-significant. This situation told that due to addition in grains per capsule, single plant yield in Brassica causes decline to some extent but by the management of essential nutrients and maximum density of plants may stabilize the grain yield per plant. However, Hybrid cultivars performed best grain yield than in open pollinated cultivars (Basalma, 2008) in winter rapeseed. Variation in Grain yield, irrespectives of cultivars may be due to difference in yield contributing parameters caused by different fertility levels. The result of current trail is also confirmed by Bazzaz et al. (2020).

Harvest index(%)

Data in Table-2 revealed significant results for canola

cultivars and fertilizers and their interaction. Among different fertilizer levels,F1 (NPK 120:60:60) gave maximum harvest index (24.69%) while F10 (control treatment) had minimum harvest index (11.65 %). In cultivars, the maximum (21.11%) harvest index was calculated in hybrid PARC Canola which was higher as compared to open pollinated cultivars Faisal Canola giving (15.51 %).The interaction between F1 (NPK 120:60:60 kgha-1) and hybrid canola showed maximum value (26.96%) in respect of harvest index followed by (25.67 %)harvest index in hybrid PARC Canola x(Half recommended Ferti Source + half recommended NPK).The minimum harvest index (8.27 %) was noted in the interaction of control and Faisal Canola (open pollinated).The hybrid cultivar has greater tendency to produce more economic yield than open pollinated cultivars because hybrids are more genetically pure and high yielding. In addition, maximum yield through artificial fertilizers might be due to its readily available property to the crop plants. Cheema (1999) reported that fertilizer application increased harvest index significantly in canola. Farooq et al.(2015) describe a positive relationship between economic yield and biomass yield of Brassica species (canola).Tuncturk and cife(2007) found a positive and significant correlation among hybrid cultivars over open pollinated Brassica species regarding harvest index.

Benefit cost ratio (BCR)/Net return

Benefit cost ratio is an important economic analysis technique which determines the economic position of different treatments. In current study, maximum net return (Rs.120439/-) was achieved form PARC Canola hybrid and NPK applied @120:60:60 kg ha-1(F1) with benefit cost ratio was 3.11. BCR of our study is shown in table 3 However, the combination ofFerti Source NPK along with PARC hybrid Canola gave more benefit cost ratio(3.19)as compared to F1 but less net return (Rs. 98801/-) per unit area.The lowest benefit cost ratio (0.98) and net return (Rs. -311/-) was calculated in control and open pollinated variety interaction.

Rate of Purchase:

Urea=Rs. 1400/- per 50 kg bag, SSP=Rs. 1350/- per 50 kg bag, SOP=Rs. 2750/- per 50 kg bag, Emamecithin benzoate=Rs. 650/- per bottle, Imidacloprid=Rs.200/- per packet, Canola seed/Grain = Rs.50/-per kg

CONCLUSION

Results clearly indicated that superiority of hybrid over open pollinated cultivar. The maximum net return (Rs.120439/-) was obtained by hybrid PARC canola along with NPK @ 120:60:60 kg NPK ha-1, however, maximum benefit cost ratio (3.19) was received from hybrid PARC Canola combination with half inorganic (60:30:30 kg NPK ha-1 + half Ferti source dose (62.5 kg ha-1). Therefore, keeping in mind the poor financial status of the peasants, the use of hybrid canola and half dose of inorganic manure along with half Ferti source will be the ideal combination, but if farmer can afford more cost, the complete dose of inorganic manures with hybrid PARC canola will be able to generate maximum income over large area.

CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

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AUTHOR CONTRIBUTIONS

IH, S and RA performed the experimental work. MYK and SA wrote the manuscript. JHS, QAJ and RAR assisted throughout the allelopathy survey, MH and GR performed statistics. MAG andIAdesigned the experimental work and assisted throughout the experimental as well as theoretical work.

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