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Nitrogen Levels, Tillage Practices and Irrigation Timing Influenced Yeild, Yeild Components and Oil Contents of Canola

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Abstract
Field experiment was conducted at Agriculture Research Institute (N) Mingora Swat, Pakistan during 2012-2013. The experiment was laid out in RCBD with split plot arrangement having three replications. Irrigation timing (12 days, 22 days and 32 days) and tillage Practices (conventional tillage with cultivator, deep tillage with chisel plough and shallow tillage with MBP) were allotted to main plots, while Nitrogen levels (0, 30, 60 and 80 kg ha^{-1}) were allotted to sub plots. Irrigation timing had significantly affected all the parameters except oil content. Water supply to crop with 12 days irrigation timing had maximum seed capsule^{-1} (27), 1000 seed weight (3.61 g), oil yield (515 kg ha^{-1}), seed yield (875 kg ha^{-1}) and biological yield (6642 kg ha^{-1}) as compared with irrigation timings. Tillage Practices had significantly effected on all the parameters except oil content. Conventional tillage produced maximum seed capsule^{-1} (23), 1000 seed weight (3.38 g), oil yield (505 kg ha^{-1}), seed yield (848 kg ha^{-1}) and biological yield (6054 kg ha^{-1}) as compared with deep and shallow tillage implements. Nitrogen application had also significantly affected all parameters. Plots treated with 80 kg P ha^{-1} produced maximum seed capsule^{-1} (27), 1000 seed weight (4 g), oil content (58.21 %) oil yield (676 kg ha^{-1}), seed yield (1160 kg ha^{-1}) and biological yield (6684 kg ha^{-1}) as compared with control plots. The interaction between tillage Practices, irrigation timings and Nitrogen levels revealed that application of water to crop with 12 days irrigation timing used conventional tillage method and treated with 80 kg P ha^{-1} had maximum seeds capsules^{-1}, 1000 seed weight, oil yield, seed yield and biological yield. Conventional tillage with 12 days irrigation timing and treated with 80 kg P ha^{-1} seems to the best choice for Canola producer in the agro-ecological condition of Peshawar valley.
Keywords: Canola (Brassica napus L.), tillage, irrigation timing, Nitrogen levels, oil content, oil yield

INTRODUCTION

Canola (*Brassica napus* L.) belongs to family Cruciferae is one of the most important oil crops grown in the tropical and subtropical area over the world. Canola is considered as a drought tolerant crop and is therefore mainly grown as dry land crop. Canola is an important edible oil seed crop however its yield very low (Average < 800 kg ha^{-1} in Pakistan [15]. It is a good source of vitamins and minerals such as calcium and phosphorous and the seed cake is also an important nutritious livestock feed [13]. The crop also contents high quality of edible oil (43–55%) and its oil has high degrees of stability and resistance to rancidity. [3]. To enhanced Canola production, soil porosity is improved by conventional tillage practices and incorporation of residues. With improvement in porosity the aeration is enhanced which ensures adequate availability of oxygen to the plant root. [5] Found that deep tillage practices improved root length and moisture availability as compared to shallow tillage. Deep tillage significantly enhanced the plant height and grain yield of Canola. Soil inversion by conventional tillage method usually led to an improvement in soil aeration, residue breakdown, organic P mineralization and the availability of P for crop use [8]. Conventional tillage farming Practices has been shown to improve crop establishment and growth through the amelioration of the adverse effects of high soil temperature, soil crusting and rapid drying of the soil surface [6] recently, reduced and no-till methods have gained popularity. The employment of no-till or reduced tillage has been shown to be economical, useful for soil aggregation, and helpful in reducing soil erosion [16]. Drought stress significantly decreased seed yield plant^{-1} in Canola but it did not influence its seed weight plant^{-1} water deficit significantly affected the yield of auxiliary branches in Canola, so that its yield was higher under normal conditions as compared to under water stress conditions. To obtain optimum yield, it is necessary to supply enough moisture by irrigation in addition to improving soil fertility [11]. [12] Showed that extending the irrigation timing from 6 to 32 days decreased Canola yield from 1780 to 1130 kg ha^{-1}, respectively. Water stress is the most important factor affecting seed yield, especially in arid and semi arid regions. Canola is one of the most important edible seeds in conventional farming in tropical and subtropical regions. [1] Reported that the application of Nitrogen fertilizer increased significantly seeds pod^{-1}, pods plant^{-1}, seed yield, oil and protein content of Canola cultivar. Supply of Nitrogen is usually associated with increased root density and proliferation, which aid in extensive exploration and supply of nutrients and water to the growing plant parts, resulting in increased growth and yield traits, there by ensuring more seed and dry matter yield [17]. Keeping in view the limitations under rainfed condition this experiment was conducted at the irrigated condition under the intensive

farming Practices. To find out the most stabile tillage Practices, irrigation timing and Nitrogen levels for higher yield at the agro-climatic condition of Peshawar.

MATERIALS AND METHODS

This research was carried out at Agriculture Research Institute (N) Mingora Swat, Pakistan *during 2012-13.* The experiment was carried out in RCBD with split plot arrangement having three replications. Tillage machineries (conventional tillage with cultivator, deep tillage with chisel plough and shallow tillage with MBP) and irrigation timings (12 days, 22 days and 32 days) were allotted to main plots, while Nitrogen levels (0, 30, 60 and 80 kg ha^{-1}) were allotted to sub plots. A subplot size of 4 m x 3 m was be used. Each sub plot was consisted of 10 rows having 40 cm row-to-row distance. Nitrogen was applied at the rate of 60 kg ha^{-1} half at time of sowing and half before flowering. Crop was sown at seed rate of 4 kg ha^{-1} using Canola cultivar local black. Number of capsule $plant^{-1}$ was counted in ten plants selected randomly in each subplot. Seed $capsule^{-1}$ was recorded by counting seed in ten capsules randomly selected. Thousand seed weight (g) were recorded from three seed lot and weighted with the help of electronic sensitive balance. For grain yield and biological yield four central rows in each sub plot were harvested, sun dried and threshed and then converted into kg ha^{-1}.

Seed oil content (%) was determined by using Soxhlet apparatus and n-hexane (60ºC) as an extraction solvent according to A.O.A.C. [4].

Oil yield can be calculated by following formula.

$$\text{Oil yield (kg ha}^{-1}\text{)} = \frac{\text{oil content \% x seed yield (kg ha}^{-1}\text{)}}{100}$$

Data collected were analyzed statistically according to the procedure relevant to RCB design. Upon significant F-Test, LSD test was used for mean comparison to identify the significant components of the treatment means [10].

RESULTS AND DISCUSSION

Number of seeds capsule^{-1}

Maximum (27) number of seeds $capsule^{-1}$ produced from 12 days irrigation timing which was greater than from 32 days irrigational timing. These results are in line with those of [12] who reported that decrease seeds $capsule^{-1}$ with increasing irrigation timing from 7 to 21 days. Tillage Practices had significant effect on number of seeds $capsule^{-1}$. Maximum (23) number of seeds $capsule^{-1}$ was recorded in CT while minimum (18) number of seeds $capsule^{-1}$ was noted in ST. Similar notations was reported by [18] who obtained higher (27) number of seeds $capsule^{-1}$ when use conventional tillage as compared to deep and shallow tillage practices. Plot treated with 80 kg P ha^{-1} produced (24) number of seeds $capsule^{-1}$ while (17) number of seeds $capsule^{-1}$ was recorded in control plots. Similar results were reported by [1] that significantly increased in seeds $capsule^{-1}$ with increase of Nitrogen level up to 88 kg ha^{-1}. Interaction between I x P indicated in that seeds $capsule^{-1}$ increased with increasing P levels in all irrigation timing but linearly increased was occurred in seeds $capsule^{-1}$ when supplied water with 12 days timing and treated with 80 kg P ha^{-1}.

Thousand seeds weight (g)

Mean value of irrigation timing revealed that with increasing irrigation timing, Seed weight decrease and heavier (3.61 g) seed weight was obtained from 12 days irrigation timing which was (21 %) greater them from 32 days irrigational timing. These results are in line with those of [11] who reported that significantly decreased in 1000 seed weight occur with increase irrigation timing from 6 to 22 days. Tillage Practices had significant effect on seed weight. Maximum (3.38 g) seed weight was produced in CT while minimum (3.26) seed weight was noted in ST but statistical had no significant difference with DT. These results are in line with the findings of [16] who reported that deep and shallow tillage reduced 1000 seed weight when compared with conventional tillage. Plot treated with 80 kg P ha^{-1} produced heavier (4 g) seed weight while minimum (2.51 g) seed weight was produced in control plots. These results are in line with those of [9] who reported the seed weight increased with increase Nitrogen level and this might be due increased root density which supply of nutrients towards crop as a result 1000-seed weight increased. Interaction between T x I x P revealed in that seed weight increased with increasing P levels in all irrigation timing and tillage Practices but linearly increased in seed weight was produced when given 12 days irrigation timing with CT and treated with 80 kg P ha^{-1}.

Seed oil content (%)

Analysis of data given in (table 1) indicated that Nitrogen levels had significantly affected oil content of Canola while irrigation timing, tillage Practices and all the interaction were found not significant effect on oil content. With increase of Nitrogen level oil content increase significantly and therefore the highest level of Nitrogen (80 kg ha^{-1}) produced maximum (58.21%) oil content while minimum (40.81%) oil content was recorded in control

plots. Similar results were reported by [14] who reported that increase in seed oil content (%) by adding Nitrogen fertilization might be attributed to important role of Nitrogen in metabolism of lipids.

Oil yield (kg ha^{-1})

Mean values in (Table 1) showed that oil yield was significantly reduced with increasing irrigation timing. Maximum (515 kg ha^{-1}) oil yield was produced from 12 days irrigation timing while minimum (365 kg ha^{-1}) oil yield was obtained from 32 days irrigational timing. These results confirm the findings of [11] who reported that decreased oil yield with increasing irrigation timing from 6 to 22 days. Tillage Practices had significant effect on oil yield. Maximum (505 kg ha^{-1}) oil yield was recorded in CT while minimum (386 kg ha^{-1}) oil yield was noted in ST. These results are in line with those of [18] who reported the higher oil yield was obtained when use conventional tillage as compared to deep and shallow tillage practices it might be due to tillage Practices which enhanced seed yield which indirectly increase oil yield. With increase of Nitrogen level oil yield increased significantly and therefore the highest level of Nitrogen (80 kg ha^{-1}) produced maximum (676 kg ha^{-1}) oil yield while minimum (161 kg ha^{-1}) oil yield was recorded in control plots. These results are in line with those of [2,17] who reported that the positive effect of P application on oil yield ha^{-1} could be due to the increase in seed yield ha^{-1} and seed oil content (%). Interaction between T x I x P revealed in (. 4) that oil yield increased significantly with increasing P levels in all irrigation timing and tillage Practices but maximum and linearly increased in oil yield was recorded when supplied water from 12 days irrigation timing with CT Practices and treated with 80 kg P ha^{-1}.

Seed yield (kg ha^{-1})

Supplied of water with 12 days irrigation timing produced maximum (857 kg ha^{-1}) seed yield while minimum (682 kg ha^{-1}) seed yield was obtained from 32 days irrigational timing. Similar results were reported by [11] who reported that 6 days irrigation timing increase (80.2%) seed yield when compared with 22 days irrigation timing. It was due to the decrease in inter-plant competition and the increase in auxiliary branch and capsules plant^{-1}. Tillage Practices had significant effect on seed yield. Maximum (848 kg ha^{-1}) seed yield was recorded in CT Practices while minimum (755 kg ha^{-1}) seed yield was recorded in ST Practices. These results are in line with those of [6] who reported that higher seed yield was obtained when use conventional tillage as compared to deep and shallow tillage practices. It might be due to high density of weeds biomass in deep tillage as compared to CT. With increase of Nitrogen level seed yield increased significantly and therefore the highest level of Nitrogen (80 kg ha^{-1}) produced maximum (1160 kg ha^{-1}) seed yield while minimum (382 kg ha^{-1}) seed yield was recorded in control plots. These results are in line with the findings [9] who reported that P plays important role in enhancing translocation of metabolites which might be the reason for the increases observed on seed yield and seed weight subsequently increased seed yield ha^{-1}. Interaction between T x I x P indicated in that seed yield increased significantly with increasing P levels in all irrigation timing and tillage Practices but linearly increased in seed yield was recorded when supplied water from 12 days irrigation timing with CT Practices and treated with Nitrogen at the rate of 80 kg ha^{-1}.

Biological yield (kg ha^{-1})

Water supplied with 12 days irrigation timing produced maximum (6642 kg ha^{-1}) biological yield while minimum (4625 kg ha^{-1}) biological yield was obtained from 32 days irrigation timing. Similar results were reported by [11] who reported that 6 days irrigation timing increase (44%) biological yield when compared with 22 days irrigation timing. It was due to the decrease in irrigation timing increased Canola vegetative growth, photosynthesis capacity and reduced inter-plant competition as a result biological yield eventually increased. Tillage Practices had significant effect on biological yield. Maximum (6054 kg ha^{-1}) biological yield was produced in CT Practices while minimum (5131 kg ha^{-1}) biological yield was produced in ST Practices. These results are in line with those of [6] who reported that higher biological yield was obtained when use conventional tillage as compared to deep and shallow tillage practices. With increase of Nitrogen level biological yield increased significantly and therefore the highest level of Nitrogen (80 kg ha^{-1}) produced maximum (6684 kg ha^{-1}) biological yield while minimum (3364 kg ha^{-1}) biological yield was recorded in control plots. These results are in line with the findings [9] who reported that P plays important role in enhancing translocation of metabolites which might be the reason for the increases observed in root density and proliferation which supply nutrients to plant as result biological yield increased. Interaction between T x I x P indicated in that biological yield increased significantly with increasing P level but beyond 60 kg P ha^{-1} further increased in biological yield was stop in all irrigation timing and tillage Practices but linearly increased in biological yield was recorded when supplied water from 12 days irrigation timing with CT Practices and treated with Nitrogen at the rate of 60 kg ha^{-1}.

Table 1. Number of capsules plant^{-1}, number of seeds capsule^{-1}, thousand seeds weight (g), oil content %, oil yield (kg ha^{-1}), seed yield (kg ha^{-1}) and biological yield (kg ha^{-1}) of Canola as affected by irrigation timing, tillage Practices and Nitrogen levels

Treatment	No. of seeds capsule^{-1}	1000 seed weight (g)	Oil content (%)	Oil yield (kg ha^{-1})	Seed yield (Kg ha^{-1})	Biological yield (kg ha^{-1})
Irrigation timing (days)						
8	27a	3.61a	50.58	515a	875a	6642a
16	23b	3.31b	50.48	443b	837b	5448b
24	20c	2.88c	50.40	365c	682c	4625c
LSD (0.05)	1.68	0.02	ns	4.84	8.71	24
Tillage Practices						
Conventional(CT)	23a	3.38a	50.84	505a	848a	6054a
Deep (DT)	21b	3.24b	50.32	421b	801b	5530b
Shallow (ST)	18c	3.26b	50.32	386c	755c	5131c
LSD (0.05)	1.68	0.02	ns	4.84	8.71	24
Nitrogen (kg ha^{-1})						
0	17d	2.51d	40.81d	161d	382d	3364d
30	23c	3.14c	48.43c	376c	777c	5668c
60	25b	3.55b	54.43b	550b	1011b	6568b
80	27a	4.00a	58.21a	676a	1160a	6684a
LSD (0.05)	0.40	0.03	0.16	4.81	8.65	16
Interaction						
I x T	ns	ns	ns	ns	ns	ns
I x P	*	ns	ns	ns	ns	ns
T x P	ns	ns	ns	ns	ns	ns
I x T x P	ns	*	ns	*	*	*

Means in the same category followed by different letters are significantly different at P ≤0.05 levels. ns = non-significant

CONCLUSION AND RECOMMENDATIONS

It was concluded from present research work that supplied water with 12 days irrigation timing used conventional tillage Practices and Nitrogen @ of 80 kg ha^{-1} can increased 1000 grain weight, oil contents and seed yield significantly and therefore, it is recommended to use irrigation timing of 12 days with conventional tillage Practices and application of Nitrogen at the rate of 80 kg ha^{-1} in order to obtained higher oil and seed yield under the conditions of the Swat valley.

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