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PHENOLOGICAL DEVELOPMENT AND WEEDS DRY MATTER PRODUCTION IN CANOLA AS AFFECTED BY PRE AND POST EMERGENCE HERBICIDES AND ROW SPACING

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ABSTRACT

An experiment was conducted at Agricultural Research Farm of NWFP Agricultural University, Peshawar during 2000-01 to study the effect of row spacing and different levels of Stomp 330 E and Puma super as pre and xpost-emergence herbicides on canola. Crop was sown according to randomized complete block design with split plot arrangement replicated four times, using three row spacings (30, 45, 60 cm) and three levels of Stomp 330 E (1.75, 2.75, 3.75 L ha^{-1}) as pre-emergence and three levels of Puma super (1, 2 3 L ha^{-1}) as post-emergence herbicides. Row spacing had non significant effect on all the parameters except 50% flowering. Minimum (102.37) days to 50% flowering were recorded for 45 cm apart rows. Weed control methods had a significant effect on all the parameters studied. Lightest weeds weight at 30 cm height (12.87 g m^{-2}) was obtained from plots receiving 2 L Puma ha^{-1} while minimum weeds weight at flowering (15.42 g) was recorded from plots receiving 3.75 L Stomp ha^{-1}. Minimum (101.42) days to 50% flowering were noted for plots treated with Stomp 3.75 L ha^{-1} while, minimum (163.17) days to maturity were recorded for Stomp 2.75 L ha^{-1}. Maximum plant height (1.55 m) and number of branches $plant^{-1}$ (8.42) were recorded at Stomp 3.75 L ha^{-1}. It was concluded that Stomp 330E at the rates of 2.75 and 3.75 L ha^{-1} as pre-emergence followed by Puma super at the rate of 2 L ha^{-1} as post-emergence were the most effective herbicides for weed control in canola.

INTRODUCTION

Brassica oil-seed crops, rape *(B. campestris* L, and *B. napus* L.) and mustard *(B.juncea)* are the third major source of edible vegetable oil in the world, after soybean and ground nut (FAO, 1985). The tender leaves of these crops serve as a vegetable and the seed as a source of lubricating and cooking oil. The residue left after oil extraction (meal) is rich in protein (Durrani and Khalil. 1990), and can be used in livestock feed (Bell. 1984). However, due to the presence of certain toxic compounds, such as erucic acid and glucosinolates has restricted their utilization in the past (Vermorel *et al.*, 1988). The recent introduction of double 00 (both erucic acid and glucosinolates) brassica oil seed cultivars called, canola, has changed the prospects of these oils and protein producing crop all over the world (Kimber, 1984).

Canola has recently been introduced to this country with the object to increase our domestic edible oil production. Research on the improved production technology will help

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us to boost our production. Amongst the many techniques row spacing and herbicides have also important role in improving availability of moisture, nutrients, light and aeration to the crop. The use of herbicides has become indispensable for the control of weeds, resulting in the diversion of nutrients and moisture etc. to the major crop plants. Sandhu et al. (1998) confirmed the presence of *Phalaris minor, Avena ludoviciana, Rumex dentatus, Anagallis arvensis, Coronopus didymus* and *Medicago denticulata* in *gobhi sarson (Brassica napus* L.). While application of herbicides gave the best weed control (up to 82%) and secured the highest seed yield (Bernotas and Kalvaitiene, 1997). Similarly Montvilas (1997) reported that the herbicide application in winter rape reduced the number of weeds by 87.8-96.3% and increased rape seed yield by .85-1.0 t ha^{-1}. Row spacing on the other hand provides sufficient space for plant canopy, which has a direct relation with space, light and aeration. So, this experiment was carried out to evaluate the impact of row spacing and herbicides on canola.

MATERIAL AND METHODS

An experiment entitled "Phenological development and weeds dry matter production in canola as affected by pre and post emergence herbicides and row spacing" was conducted at Malakandher Research Farm, N.W.F.P. Agricultural University, Peshawar. The crop was sown on November 7, 2000 according to RCB (Randomized complete block) design with split plot arrangement replicated four times in a net sub-plot of 2.4m x 5m (12m^{2}). The row spacings (30, 45, and 60 cm) were allotted to main plots while three levels of pre-emergence Stomp 330 E (1.75, 2.75, and 3.75 L ha^{-1}), 3 levels of post-emergence Puma super (1, 2, and 3 L ha^{-1}), hand weeding and weedy check were allotted to sub-plots. The data were recorded on weed flora, dry matter of weeds m^{-2} (30 cm height and flowering of the crop), days to 50% flowering, days to maturity, plant height (m), and number of branches plant^{-1}.

RESULTS AND DISCUSSION

Weed Flora

Different weed species collected from the field showed that most of the weeds were dicot. In monocots *Phalaris minor* was the most frequently observed in the field. Weeds were identified according to classifications based on leaf and seed morphologies, life cycle and family (Table 1). Pre-emergence Stomp 330 E effectively controlled most of broad leaf weeds and monocots. Similar reports were also shown by Sandhu *et al* (1998).

Weeds weight (g m^{-2}) at 30 cm height and at flowering

Weeds weight was significantly affected by herbicides and interaction of row spacing and weed control treatments (SxT). However, row spacing remained non-significant. Amongst the herbicides lowest weeds weight (12.87 g m^{-2}) was recorded for 2 L Puma super ha^{-1} at 30 cm height (Table 2). Same report is also given by Ojcyzk (1996) who stated that post sowing application of herbicide reduced weeds biomass. Interaction (SxT) showed that lowest weeds weight (8.34 g m^{-2}) was produced by 45 cm apart rows receiving 3.75 L Stomp ha^{-1}. It was lower statistically at for with several interaction involving all row spacings and different doses of Puma super (Table 2). The highest biomass of weeds (115.56 and 109.17 g m^{-2}) were in the weedy check under 60 and 45 cm row spacing respectively.

Weeds weight (g m^{-2}) at flowering

Significant effect was observed for herbicides and interaction (SxT) on weeds weight at flowering of the crop while row spacing had no significant effect on weeds weight (Table 3). Application of 3.75 L Stomp ha^{-1} as pre-emergence herbicide showed a reduced weeds weight (15.42 g m^{-2}) at flowering. Similarly reported by Khan *et al.* (1995) who reported that pre-emergence application of treflan at 1.0-2.0 l ha^{-1} in rapeseed and 1.0-1.5 l ha^{-1} in mustard significantly reduced the weed density and dry weight. Between SxT interaction lowest weeds weight (10.56 g m^{-2}) was produced by 45 cm apart rows receiving 3.75 L Stomp ha^{-1}. The highest biomass of weeds at flowering was recorded in the weedy check at 60 cm (151.11 g m^{-2}) and 45 cm (147.78 g m^{-2}).

Days to 50% flowering

Row spacing and weed control treatments significantly affected days to 50% flowering of canola (Table 4). Minimum days (102.37) to 50% flowering in canola were recorded for 45 cm apart rows. The optimum plant to plant distance in 45 cm apart row spacing minimized competition for space, moisture and nutrients. Amongst the herbicides minimum days (101.67) were observed in plots treated with 2.75 L Stomp ha^{-1} due to the efficient control of weeds by pre-emergence herbicide. Maximum days to 50% flowering of canola were 109.50 and 108.50 recorded for 60 and 45 cm apart row spacing respectively, from the weedy check.

Days to maturity

Weed control treatments had a significant effect on days to maturity (Table5). Minimum days to maturity (163.17) were recorded from plots receiving 2.75 L Stomp ha^{-1}. Row spacing remained non-significant for days to maturity. This result is in agreement with that of Saini and Sidhu (1998) who reported that phenology was not significantly affected by row spacing (30-60 cm) or N rate (50-150 kg ha^{-1}); except for number of days to maturity increasing slightly with increasing row width and N rate. Maximum days to maturity were noted in the weedy check for 60 cm (176.25) and 45 cm (175.25) apart row spacing.

Plant height (m)

Data on plant height (Table 6) revealed that tallest plant height (1.55 m) was recorded from plots treated with 3.75 L Stomp ha^{-1} as pre-emergence herbicide. However plant height was not significantly affected by row spacing and interaction. Similar results were also given by Montvilas (1999) who reported that sowing rate and spacing did not significantly affect plant height. Lowest data regarding plant height was obtained from 30 and 60 cm (1.37 m) and 45 cm (1.26 m) apart row spacing in the weedy check.

Number of branches $plant^{-1}$

Data obtained for number of branches $plant^{-1}$ (Table 7) showed that weed control treatments and interaction (SxT) significantly affected number of branches $plant^{-1}$. Maximum number of braches $plant^{-1}$ (8.48) were obtained from plots receiving 3.75 L Stomp ha^{-1} while minimum number of 6.71 braches $plant^{-1}$ were recorded from check plots. The SxT interaction showed that maximum number of branches $plant^{-1}$ (9.27) were recorded from 60 cm apart rows receiving 2.75 L Stomp ha^{-1}. Data regarding branches $plant^{-1}$ was not significantly affected by row spacing. Similar results were also given by Gurkirpal *et al.* (1991) who stated that plant density increasing from the optimum did not have any significant effect on number of branches.

Table-1. Common weed species found in the field are listed below

Botanical name	Common name	Classification based on			
		Leaf morphology	Seed morphology	Life cycle	Family
Cyperus rotundus	Purple nutsedge	Sedge	Monocot	Perennial	Cyperaceae
Phalaris minor	Canary grass	Grass	Monocot	Annual	Poaceae
Chenopodium album	Common lambsquarters	Broadleaf	Dicot	Annual	Chenopodiacea
Convolvulus arvensis	Field bindweed	Broadleaf	Dicot	Perennial	Convolvulaceae
Euphorbia esula	Leafy spurge	Broadleaf	Dicot	Perennial I	Euphorbiacea
Rumex crispus	Curly dock	Broadleaf	Dicot	Perennial I	Polygonacea
Setaria viridis	Green foxtail	Grass	Monocot	Annual	Poaceae
Taraxacum officinale	Common dandelion	Broadleaf	Dicot	Perennial I	Compositae
Digitaria sanguinalis	Large crabgrass	Grass	Monocot	Annual	Graminea
Plantago lanceolata	Buckhorn plantain	Broadleaf	Dicot	Perennial I	Plantaginaceae

Table-2. Weeds weight (g m^{-2}) at 30 cm height of canola as affected by different levels of pre and post-emergence herbicides and row spacing

Row spacing (cm)	Herbicides						Hw	Check	Mean
	Stomp 330 E (L ha^{-1})			Puma super (L ha^{-1})					
	1.75	2.75	3.75	1	2	3			
30	15.83e-i	11.95ghi	18.33c-h	14.72 e-i	12.78f-i	24.17cd	20.00c-f	97.50b	26.91
45	18.89c-g	16.39d-h	8.34i	25.84 c	15.00e-i	15.83e-i	23.89cd	109.17a	29.17
60	20.97cde	11.39ghi	17.64d-h	12.78f-i	10.84hi	14.30e-i	25.83c	115.56a	28.66
Mean	18.56c	13.24de	14.77cde	17.78cd	12.87e	18.10c	23.24b	107.41a	

LSD value for weed control treatments = 4.61
LSD value for interaction = 7.98

Means of the same category followed by different letters are significantly different using LSD test.

Table-3. Weeds weight (g m^{-2}) at flowering of canola as affected by different levels of pre and post-emergence herbicides and row spacing

Row spacing (cm)	Herbicides						Hw	Check	Mean
	Stomp 330 E (L ha^{-1})			Puma super (L ha^{-1})					
	1.75	2.75	3.75	1	2	3			
30	24.72fgh	17.22hij	15.84hij	22.50f-i	20.56g-j	31.11def	31.39def	133.89b	37.15
45	40.00cd	19.72g-j	10.56j	42.50c	10.89j	13.89ij	44.72c	147.78a	42.26
60	36.67cde	15.83ij	19.86g-j	28.33efg	25.69hij	11.11j	46.25c	151.11a	40.61
Mean	33.80c	17.59d	15.42d	31.11c	18.38d	18.70d	40.79b	144.26a	

LSD value for weed control treatments = 5.91
LSD value for interaction = 10.24

Means of the same category followed by different letters are significantly different using LSD test.

Table-4. Days to 50% flowering of canola as affected by different levels of pre and post-emergence herbicides and row spacing

Row spacing (cm)	Herbicides						Hw	Check	Mean
	Stomp 330 E (L ha^{-1})			Puma super (L ha^{-1})					
	1.75	2.75	3.75	1	2	3			
30	106.00a-e	101.75d-g	100.50fg	106.75a-d	106.75a-d	104.75a-g	103.00c-g	106.75a-d	104.53 a
45	108.25abc	101.75d-g	99.75g	104.25a-g	99.75g	102.00d-g	102.75d-g	108.50ab	102.37 a
60	100.75efg	101.50d-g	104.00b-g	105.25a-f	103.75b-g	102.75d-g	105.00a-g	109.50a	105.06 a
Mean	105.00c	101.67c	101.42c	105.42ab	103.42bc	103.17bc	103.58bc	108.25a	

LSD value for row spacing = 5.77

LSD value for weed control treatments = 3.08
LSD value for interaction = 5.34

Means of the same category followed by different letters are significantly different using LSD test.

Table-5. Days to maturity of canola as affected by different levels of pre and post-emergence herbicides and row spacing

Row spacing (cm)	Herbicides						Hw	Check	Mean
	Stomp 330 E (L ha^{-1})			Puma super (L ha^{-1})					
	1.75	2.75	3.75	1	2	3			
30	170.00bcd	164.50e-j	162.75hij	169.00c-f	168.50c-g	166.50d-j	166.25d-j	172.75abc	167.53
45	162.75hij	162.50i-j	162.00ij	168.00c-h	15.25d-j	163.75f-j	167.00d-j	175.25ab	165.81
60	169.50cde	162.50i-j	166.00d-j	168.50c-g	161.50j	163.50g-j	168.00c-h	176.25a	166.97
Mean	167.42bc	163.17d	163.58d	168.50b	165.08cd	164.58cd	167.08bc	174.75a	

LSD value for weed control treatments = 3.10
LSD value for interaction = 5.36

Means of the same category followed by different letters are significantly different using LSD test.

Table-6. Plant height (m) of canola as affected by different levels of pre and post-emergence herbicides and row spacing

Row spacing (cm)	Herbicides								
	Stomp 330 E (L ha^{-1})			Puma super (L ha^{-1})			Hw	Check	Mean
	1.75	2.75	3.75	1	2	3			
30	1.40d-g	1.43c-f	1.55bc	1.50a-e	1.43c-f	1.47a-f	1.46a-f	1.37efg	1.45
45	1.56abc	1.53a-d	1.54a-d	1.50a-e	1.42c-f	1.48a-e	1.33fg	1.26g	1.45
60	1.38efg	1.60a	1.55abc	1.45b-f	1.46a-f	1.54a-d	1.46a-f	1.37efg	1.48
Mean	1.45bc	1.52ab	1.55a	1.49abc	1.44bc	1.50abc	1.42cd	1.34d	

LSD value for weed control treatments = .08
LSD value for interaction = .14

Means of the same category followed by different letters are significantly different using LSD test.

Table-7. Number of branches $plant^{-1}$ of canola as affected by different levels of pre and post-emergence herbicides and row spacing

Row spacing (cm)	Herbicides								
	Stomp 330 E (L ha^{-1})			Puma super (L ha^{-1})			Hw	Check	Mean
	1.75	2.75	3.75	1	2	3			
30	7.01f-j	6.93f-j	8.13a-h	8.85a-d	7.91a-i	7.44bc	6.75g-j	6.59hij	7.45
45	8.28a-g	7.85a-i	8.91abc	7.58b-i	8.43a-f	6.02j	7.32d-j	6.48ij	7.6
60	7.14f-j	9.27a	8.36a-f	7.76a-i	9.06ab	8.70a-e	7.21e-j	7.06f-j	8.07
Mean	7.48bc	8.02ab	8.48a	8.06ab	8.47a	7.39bc	7.09c	6.71c	

LSD value for weed control treatments = .89
LSD value for interaction = 1.54

Means of the same category followed by different letters are significantly different using LSD test.

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