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WEED DENSITY AND STRAWBERRY YIELD AS AFFECTED BY HERBICIDES AND MULCHING TECHNIQUES

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ABSTRACT

A field experiment was carried out to evaluate the effect of different row spacing and weed control methods on weed density and strawberry yield. The strawberry variety "Chandler" plantlets were imported from Swat for conduction of the experiment. Three different row-row spacings (30 cm, 60 cm and 90 cm) and eight different weed control strategies i.e. Stomp (pendimethalin) @ 2.5L, Dual gold (s-metolachlor) @ 1L, Percept (haloxyfop-p-methyl) @ 0.9L ha^{-1}, white plastic mulch, wheat straw mulch, saw dust mulch, hand weeding and weedy check were used in the experiment. Using an RCBD design with split plot arrangement, the row-row spacings were assigned to main plots while different weed control methods were allotted to sub plots. The results showed maximum weed density of 165 m^{-2} recorded in treatments of 90 cm row spacing while lowest weed density of 131 m^{-2} was recorded in 30cm row spacing. Similarly, among the weed control treatments maximum weed density (262 m^{-2}) was noted in weedy check and minimum (65 m^{-2}) was observed for hand weeded plots followed by herbicide Percept (114 m^{-2}) and white plastic mulch (117 m^{-2}). Highest number of fruit plant^{-1} and total fruit yield (kg ha^{-1}) noticed for 60 cm row spacing while lowest was recorded for 90 cm row spacing. Similarly, among the weed control strategies hand weeding followed by percept herbicides resulted better in the above mentioned parameters as compared to weedy check. It is concluded that Percept herbicide with 60 cm row spacing is very effective for controlling weeds in strawberry, while among mulches white plastic could be used to obtained more yield of strawberry in agro-ecological conditions of Peshawar.

Key words: Herbicides, mulches, strawberry, weed competition, yield losses.

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INTRODUCTION

Strawberry (*Frageria ananassa* Dutch) is a herbaceous perennial crop belonging to family Rosaceae. It is a small fruit crop of great nutritional and medicinal value (Maas *et al.,* 1991). In Pakistan, the major growing areas are Swat, Abbottabad, Mansehra, Haripur, Gujrat, Sialkot, Jhelum, Chakwal, Karachi Mardan and Charsadda. It is grown for commercial purpose and is gaining importance among the growers of Khyber Pakhtunkhwa as a cash crop, where it is grown in the month of November; fruit matures in late April and early May and continues till June (Dad, 2011). Strawberries are extremely vulnerable to weed competition and can harbor pathogens and insects that are deleterious to crop. Vezina and Bouchard (1989) reported that weeds in strawberry planting reduced yield by 50% in the first year and attributed this reduction to inhibited rooting of daughter plants and delayed development of mother plant. Pritts and Kelly (2001) reported that yield losses by weeds might reached to 65% if weeds were not controlled at early stage. Profitable strawberry production depends on effective weed management. The effective weed control can be accomplished through integrated weed management i.e. field selection, crop rotation, hand weeding, mulching and herbicide (Fennimore and Haar, 2003). Chemical weed control method is preferred over other weed control methods because it is quick, more effective and relatively cheaper (Shah *et al*., 1989). Herbicides have given land managers a cheap and effective means of weed control (Robinson, 2009). Mulching is an effective method of covering soil surface helps to provided proper soil moisture for germination, reduction in soil erosion, improving soil structure and is used as mulch for controlling weeds (Gaire *et al*., 2013). Row spacing is one of the most important yield limiting factors because proper nutritional area is necessary to exploit available resources judiciously. Row spacing plays an important role in determining yield and yield components (Rizzardi and Kuffel, 1993). Adjusting row spacing is an important tool to optimize crop growth and the time required for canopy closure, along with maximum biomass and grain yield (Ball *et al*., 2000; Turgut *et al*., 2005; Svecnjak *et al*., 2006; Haddadchi and Gerivani, 2009; Yazdifar and Ramea, 2009). Keeping in view the losses caused by weeds an experiment was carried out with the objectives to figure out the effect of row spacing on the management of weed and yield of strawberry and to suggest the most suitable control method for

controlling weeds in strawberry in the agro-ecological conditions of Peshawar.

MATERIAL AND METHODS

To study the potential of different row spacing and weed control methods on strawberry (variety; Chandler) yield, a field experiment was conducted during winter season of 2012-13 at New Developmental Farm of the University of Agriculture, Peshawar-Pakistan. A randomized complete block design was used with split plot arrangement. There were three main plots i.e. 30, 60 and 90 cm row spacing and eight sub-plots containing different weed control techniques i.e., Stomp, Dual gold, Percept, white plastic, wheat straw, saw dust, hand weeding and weedy check.

All the treatments were applied after one week of emergence. Hand weeding was done three times with the help of hand hoe in the hand weeding treatment. The crop was irrigated according to its requirements. The recommended dose of nitrogen, phosphorus and potassium i.e. 60 kg ha^{-1} N, 80 kg ha^{-1} P and 80 kg ha^{-1} K, were applied in the form of urea, DAP and SOP, respectively.

The data were recorded from different treatments on the following parameters weed density (m^{-2}), number of fruit $plant^{-1}$ and total fruit yield (kg ha^{-1}).

RESULTS AND DISCUSSION

Weed density (m^{-2})

The analysis of variance of data showed that weed density in strawberry was significantly affected by row spacing and different weed control methods, however; their interaction was non-significant (Table-1). Means in Table-1 showed that the maximum weed density (165.95 m^{-2}) was recorded for 90 cm row spacing while the lowest mean (131.82 m^{-2}) was deciphered for 30 cm row spacing. The data for the weed control treatments showed maximum mean density (262.73 m^{-2}) for weedy check plots and minimum (65.73 m^{-2}) was observed for hand weeding plots followed by percept (114.30 m^{-2}) and white plastic (117.47 m^{-2}). As for the interaction of row spacing and weed control methods, the highest weed density (284.70 m^{-2}) was recorded for 90 cm row spacing x weedy check while minimum weed density of (46.40 m^{-2}) was noted for 30 cm row spacing x hand weeding. The high weed density in wider spacing (90 cm) might be due to availability of more space for weed seeds to germinate. However, in narrow row spacing minimum weed density might be due less space, moisture, nutrients and more inter and intraspecific competition. The same results were also recorded by Khan *et al.* (2009) who reported that maximum weed density was produced in 40

cm row spacing plots as compared to 20 cm. In another study it was noticed that wider spacing had more weed density as compared to narrow spacing (Rasmussen, 2004; Mahmood *et al.*, 2001; Sangoi *et al*., 2001; Maqbool *et al*., 2006). Similarly, Naveed *et al*. (2008) also reported that hand weeding and post emergence herbicides significantly reduced weed density. The results are similar to Din *et al*. (2011) who reported that post-emergence herbicide reduced weed density as compared to pre-emergence herbicides. Our results are in greatly analogy with Bakht *et al*. (2009) who reported that among mulches, white plastic mulch minimized weed density.

Table-1. Weed density (m^{-2}) as affected by different row-row spacing and different weed control methods.

Treatment	Row Spacing			Mean
	30 cm	60 cm	90 cm	
Stomp	146.43	153.43	162.23	154.03 c
Dual gold	134.53	138.87	181.30	151.57 c
Percept	98.43	102.57	141.90	114.30 e
White Plastic as mulch	111.07	115.80	125.53	117.47e
Wheat straw as mulch	154.03	169.00	187.70	170.24 b
Saw dust as mulch	123.40	127.27	160.57	137.08 d
Hand weeding	46.40	67.17	83.63	65.73 f
Weedy check	240.27	261.67	284.70	262.73 a
Mean	131.82 c	141.97 b	165.95a	

$LSD_{0.05}$ Row spacing = 9.96, $LSD_{0.05}$ Treatments = 12.076, $LSD_{0.05}$ Interaction = 20.916

Number of fruits plant^{-1}

The analysis of variance of data showed that number of fruit plant^{-1} of strawberry were significantly affected by row spacing and different weed control methods, their interaction was also found significant (Table-2). Means in the data table-2 showed that maximum number of fruits plant^{-1} (7.07) was recorded for 60 cm row spacing while the lowest (4.61) was deciphered for 90 cm row spacing. The mean data for the treatment showed that maximum (9.14) number of fruits plant^{-1} was noted for hand weeding plots and minimum number of fruits plant^{-1} (3.24) was noticed for weedy check plots. In short percept herbicide showed maximum number of fruit plant^{-1} (7.72) while among mulches white plastic mulch resulted highest number of fruit plant^{-1} (7.27). The results of the percept and white plastic were also statistically at par to each other. The best result in the hand weeding, percept and white plastic as mulch treatment might be because of less number of weeds. Moreover, the less weed competition and availability of more resources resulted in maximum number of

fruit plant^{-1}. As for the interaction of row spacing and different weed control methods, the highest value (12.60) was recorded for 60 cm row spacing x hand weeding and lowest (2.46) was noted for 90 cm row spacing x weedy check plots. Our results are similar to Mehla *et al*. (2000) who illustrated that altering spacing could significantly affect different yield parameters. Tesfaye (2008) revealed that spacing is the most important factor which might affect yield and different yield components.

Table-2. Number of fruit plant^{-1} as affected by different row-row spacing and different weed control methods.

Treatment	Row Spacing			Mean
	30 cm	60 cm	90 cm	
Stomp	4.70 ghi	5.86 de	4.10 i	4.88 d
Dual gold	4.06 i	4.83 fghi	3.99 i	4.29 e
Percept	8.70 b	8.36 bc	6.10 d	7.72 b
White Plastic as mulch	7.70 c	8.533 bc	5.60 defg	7.27 b
Wheat straw as mulch	5.63 def	6.30 d	4.60 hi	5.51 c
Saw dust as mulch	5.10 efgh	5.80 de	4.40 hi	5.10 cd
Hand weeding	9.20 b	12.60 a	5.63 def	9.14 a
Weedy check	2.96 j	4.30 hi	2.46 j	3.24 f
Mean	6.00 b	7.07 a	4.61 c	

$LSD_{0.05}$ Row spacing = 0.40, $LSD_{0.05}$ Treatments = 0.52, $LSD_{0.05}$ Interaction = 0.90

Total fruit yield (kg ha^{-1})

The analysis of variance of fruit size showed significant results for row spacing and weed control methods; their interaction was also found significant (Table-3). Means in the data table showed that maximum yield (4213.2 kg ha^{-1}) was recorded for 60 cm row spacing while the lowest yield (3051.2 kg ha^{-1}) was recorded for 90 cm row spacing. The mean data for different weed control treatments showed that maximum (5080.7 kg ha^{-1}) fruit yield was noted for hand weeding plots and minimum fruit yield (2193.7 kg ha^{-1}) was observed for weedy check plots. As for the interaction of row spacing and different weed control methods, the highest value (6446 kg ha^{-1}) was recorded for 60 cm row spacing x hand weeding and lowest (2004.1 kg ha^{-1}) was noted for 90 cm row spacing x weedy check plots. From the results we concluded that maximum yield in 60 cm row spacing might be due proper number of plants per hectare with proper resource management. Whereas, minimum yield in 90 cm row spacing might be due to less number of plants per hectare which produced less number of fruits, another reason could be the availability of more space to

germinate more weed seed which caused low yield. However being had highest number of plants per hectare in 30 cm row spacing the yield is minimum, it might be due to both intra-specific and inter-specific competition. Data regarding to various weeds control treatment illustrated that maximum yield in hand weeded and other weed control treatments could be due to low weed density and more nutrients availability vice versa. Maqbool *et al*. (2006) reported that reducing spacing increased plant competition which caused reduction in yield while too wide spacing resulted in excessive weed density. Singh *et al*. (2005) observed that yield is significantly decreased by increasing row spacing. Our results are similar to Halesh *et al*. (2000) and Gowda *et al*. (2006) they observed significant effect on yield and yield component of crop at varying row spacing. Rajablariani *et al*. (2012) reported that clear plastic mulch produced early and highest fruit yield. Sonkar *et al*. (2012) reported that among different mulching treatments polyethylene much performed better than organic mulch i.e. leaf mulch, straw mulch and grass mulch.

Table-3. Total fruit yield (kg ha^{-1}) as affected by different row-row spacing and different weed control methods.

Treatment	Row Spacing			Mean
	30 cm	60 cm	90 cm	
Stomp	2943.4 jklm	3400.3 gh	2832.5 klm	3058.7 e
Dual gold	2643.7 mn	3233.0 ghij	2739.0 lm	2871 e
Percept	4554.0 c	5263.2 b	3504.6 fg	4440.6 b
White Plastic as mulch	4222.0 cd	5087.0 b	3406.9 gh	4238.6 c
Wheat straw as mulch	3331.0 ghi	3845.3 ef	3013.9 ijkl	3396.7 d
Saw dust as mulch	3588.5 fg	4077.1 de	3101.7 hijk	3589.1 d
Hand weeding	4988.5 b	6446.0 a	3807.7 ef	5080.7 a
Weedy check	2222.9 o	2354.1 no	2004.1 o	2193.7 f
Mean	3561.7 b	4213.2 a	3051.2 c	

$LSD_{0.05}$ Row spacing = 179.97, $LSD_{0.05}$ Treatments = 198.72, $LSD_{0.05}$ Interaction = 344.20

CONCLUSION

In light of the results, it is concluded that the herbicides, mulches and hand weeding have the potential for reduction in weed density and improvement in strawberry yield. Row spacing of 60cm in strawberry is very effective. Hand weeding, the herbicide Percept and white plastic as mulch treated plots are also effective. However, hand weeding took higher labor costs, which by existence of herbicides is not feasible. Thus, the herbicide percept @ 0.9 L a.i. ha^{-1} and white

plastic mulch are recommended to be used in strawberry for better weed control and economical yield in agro-ecological conditions of Peshawar.

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