Pak. J. Bot., 52(6): 1999-2002, 2020. DOI: http://dx.doi.org/10.30848/PJB2020-6(45)

COMPARISONS OF WEED SUPPRESSION AND STRAWBERRY YIELD OBTAINED WITH ORGANIC AND SYNTHETIC MULCHES AND HERBICIDES

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Abstract

An experiment was conducted to find the possibilities of weed suppression in strawberry through mulches and herbicides by observing fresh weed biomass and phenology of strawberry. The trial was laid out in RCB design at "New Developmental Farm" The University of Agriculture, Peshawar. Three different row-row spacing (30 cm, 60 cm and 90 cm) and eight different weed control strategies (Stomp (pendimethalin), Dual gold (S-metolachlor), Percept (haloxyfop-p-methyl), white plastic mulch, wheat straw mulch, saw dust mulch, hand weeding and weedy check) were used in the experiment. The results showed that maximum weed suppression was found for plots with hand weeding. However percept herbicide also caused low fresh weed biomass and dry weed biomass. Row spacing and different weed control methods significantly affected most of the growth and yield related parameters of strawberry. Results revealed that fresh and dry biomass were higher in wider row spacing (90 cm) in control plots. Whereas the minimum was deciphered for 30 cm row spacing and hand weeding treatment followed by Percept and white Plastic used as mulch. Data regarding fruit size showed that highest number of fruit size were noticed for 60 cm row spacing for hand weeding and percept treatments and less was noted at 90 cm row spacing in weedy checks. From the study we concluded that hand weeding in 60 cm row spacing along with application of herbicide Percept could be effective for the management of weeds in strawberry, similarly, use of white plastic as a mulch may decrease weeds infestation and improve yield of strawberry in agro-ecological conditions of Peshawar.

Key words: Strawberry, Weed biomass, Herbicide and mulching.

Introduction

Strawberries are among the most popular fruits consumed worldwide (Anon., 2019). In Khyber Pakhtunkhwa it is grown in swat, abbotabad, Mansehra, Mardan and Charsadda and being a commercial crop it gain a great importance among the grower of Khyber Pakhtunkhwa (Dad, 2018). Strawberry is low creeping growth habit plant and is very sensitive to weed competition and cannot compete with taller and fast growing weeds (Marvin & Mary, 2004). Weed is an unwanted and undesirable plant which competes for resources and causes devastating yield losses if not properly controlled (Saeed *et al*., 2015; Saeed *et al*., 2014 and Hashim *et al*., 2013). To reduce yield losses and to get profitable strawberry production, it needs an effective weed management which can be achieved by the integration of different weed control practices i.e., field selection, crop rotation, herbicide, mulching and hand weeding. Among different weed control methods chemical weed control is the quick and good supplement to traditional methods of weed control. Under such circumstances, judicial use of herbicides is the only suitable way for controlling weed (Patel *et al*., 2006). Mulching is another method to decrease weed problems in strawberry. Different kinds of materials are used as mulch for both in field and home gardening. Some of these are organic mulch such as saw dust, wheat straw, residues, weeds or trash and some are synthetic mulches as plastic, polyethylene and paper. Uses of mulching with higher rates have a significant effect on weed density (Jayakumar & Jagannathan, 2007). Row spacing is one of the most important yield limiting factors because proper nutritional area is necessary to exploit available resources judiciously.

Materials and Methods

To investigate the impact of various row spacing and weed control techniques on strawberry (variety; Chandler) yield, a field experiment was laid out at New Developmental Farm, The University of Agriculture, Peshawar-Pakistan. The design used was RCB with split plot arrangement with three replications. Main plot were comprised of three row spacing i.e. 30, 60 and 90 cm row spacing while sub-plots encompassed eight treatments i.e., Stomp, Dual gold, percept, white plastic, wheat straw, saw dust, hand weeding and weedy check. Hand weeding was done three times with the help of hand hoe in the hand weeding treatment. 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 observations were taken during experiment fresh weed biomass (kg ha^{-1}), fruit size (cm^3), days to 50% flowering, fruit set (50%) and1st picking.

Results and Discussion

Fresh weed biomass (kgha^{-1}): Statistical analysis of the data revealed significant differences for fresh weed biomass. Means in the data revealed that the highest fresh weed biomass (735.54 kg ha^{-1}) was noted for 90 cm row spacing, while the lowest (639.60 kg ha^{-1}) were recorded for 30 cm row spacing (Table 1). The data for the treatment mean show that maximum fresh weed biomass (901.47 kg ha^{-1}) was observed for weedy check while minimum (285.7 kg ha^{-1}) were recorded for hand weeded plots. However, among the herbicides and mulches percept herbicides and white plastic mulch resulted in

minimum fresh weed biomass of (695.35) and (695.23), respectively. As for the interaction of row spacing and weed control methods, the highest value (968.43 kg ha^{-1}) was recorded for 90 cm row spacing x weedy check and minimum (244.60 kg ha^{-1}) was noted for 30 cm row spacing x hand weeding plots. The results were similar to Begna *et al*., 2001 who reported that weed biomass significantly reduced by reducing row spacing. Qasem, 2006 also reported that hand weeding and herbicide application reduced fresh weed biomass.

Days to flowering (50 %): Days to flowering of strawberry were significantly affected by row spacing and different weed control methods while their interaction was also found significant. Means in the data showed that maximum days to flowering (117.85) were recorded for 90 cm row spacing while the lowest (107.73) was noticed for 30 cm row spacing (Table 2). However, among different weed control treatments maximum (128.94) days to flowering was noted for weedy check plots and minimum (100.3 %) days to flowering was observed for hand weeding plots which was statistically at par with white plastic mulch (102.76). As for the interaction of row spacing and different weed control methods, the highest value (131.73) was recorded for 90 cm row spacing x weedy check and minimum (91.17) was noted for 30 cm row spacing x hand weeding. Our results are similar to Ozer (2003) who recorded a considerable increased in days to flowering by increasing row spacing. Hussen *et al*., (2013) also reported that proper spacing and density significantly affected number of days to flowering. Uselis (2000) also observed that wider spacing affected the days required for inflorescence. Our results are coincides with Rehman *et al*., (2012) who observed highest days to flowering for stomp and dual gold. Madukwe *et al*., (2012) reported that plots that received different weed control methods got earlier flowering while controlled plots took maximum days to flowering.

Days to fruit set (50 %): Days to fruit set of strawberry were significantly affected by row spacing and different weed control methods, however their interaction was also found significant. Means in the data showed that maximum days to fruit set (127.69%) was recorded for 90 cm row spacing while the lowest (115.99%) was recorded for 30 cm row spacing (Table 3). The mean data for treatment mean showed that maximum (138.86%) days to fruit set was noted for weedy check plots and minimum days to fruit set (107.89%) was observed for hand weeding plots which was statistically at par with white plastic as mulch (110.90%). As for the interaction of row spacing and different weed control methods, the highest value (142.33%) was recorded for 90 cm row spacing x weedy check and lowest (98.33%) was noted for 30 cm row spacing x hand weeding plots. Mehla *et al*., (2000) has communicated the analogous finding who reported that proper spacing significantly affected yield and yield component of crop. The same results were found by Rehman *et al*., (2012) who illustrated that high weed density affected days to fruiting in weedy check plots, however on other side all weed management techniques applied to plots took less time for fruiting.

Table 1. Fresh weed biomass (kgha^{-1}) as affected by different row-row spacing and different weed control methods.

Treatment	Row Spacing			Mean
	30 cm	60 cm	90 cm	
Stomp	670.77 fg	737.43 cd	762.10 cd	723.4 c
Dual gold	678.20 efg	744.57 cd	779.27 c	729.02 c
Percept	621.73 h	723.13 de	741.20 cd	695.35 d
White Plastic as mulch	642.10 gh	717.03 def	726.57 de	695.23 d
Wheat straw as mulch	742.30 cd	779.27 c	889.97 b	803.84 b
Saw dust as mulch	647.87 gh	732.77 d	736.13 cd	705.59 cd
Hand weeding	244.60 j	317.09 i	295.63 i	285.7 e
Weedy check	869.23 b	866.73 b	968.43 a	901.47 a
Mean	639.60 c	702.25 b	735.54 a	

LSD $_{0.05}$ value for Row spacing = 28.20, LSD $_{0.05}$ value for Treatments = 24.76, LSD $_{0.05}$ value for Interaction = 42.90

Table 2. Days to flowering (50 %) of strawberry as affected by different row-row spacing and different weed control methods.

Treatment	Row Spacing			Mean
	30 cm	60 cm	90 cm	
Stomp	120.33 bcd	124.27 abc	127.67 ab	124.09 b
Dual gold	110.83 efg	115.60 de	124.27 abc	116.90 c
Percept	115.57 def	107.83 fgh	116.30 cde	113.23 cd
White plastic as mulch	93.70 jk	101.47 hij	113.10 def	102.76 ef
Wheat straw as mulch	104.17 ghi	110.93 efg	114.77 def	109.96 d
Saw dust as mulch	99.17 ij	107.73 fgh	109.80 efg	105.57 e
Hand weeding	91.17 k	103.77 ghi	105.17 ghi	100.03 f
Weedy check	126.90 ab	128.20 ab	131.73 a	128.94 a
Mean	107.73 c	112.47 b	117.85 a	

LSD $_{0.05}$ value for Row spacing = 3.84, LSD $_{0.05}$ value for Treatments = 4.35, LSD $_{0.05}$ value for Interaction = 7.53

Table 3. Days to fruit set (50 %) as affected by different row-row spacing and different weed control methods.

Treatment	Row Spacing			Mean
	30 cm	60 cm	90 cm	
Stomp	129.80 cd	134.17 bc	137.63 ab	133.87 b
Dual gold	118.13 efghi	123.43 defg	137.20 abc	126.26 c
Percept	124.60 def	117.07 fghi	125.40 de	122.36 cd
White plastic as mulch	100.80 lm	109.67 jk	122.23 defg	110.90 ef
Wheat straw as mulch	112.90 hijk	119.73 efgh	123.97 defg	118.87 d
Saw dust as mulch	107.33 kl	116.50 ghij	119.20 efghi	114.34 e
Hand weeding	98.33 m	111.77 ijk	113.57 hijk	107.89 f
Weedy check	136.00 abc	138.23 ab	142.33 a	138.86 a
Mean	115.99 c	121.32 b	127.69 a	

LSD $_{0.05}$ value for Row spacing = 3.30, LSD $_{0.05}$ value for Treatments = 4.25, LSD $_{0.05}$ value for Interaction = 7.35

Table 4. Days to 1st picking as affected by different row-row spacing and different weed control methods.

Treatment	Row spacing			Mean
	30 cm	60 cm	90 cm	
Stomp	151.70	155.83	161.10	156.21 b
Dual gold	140.33	145.36	155.07	146.92 c
Percept	145.17	138.17	149.47	144.27 cd
White plastic as mulch	120.63	129.68	143.34	131.22 fg
Wheat straw as mulch	132.67	140.00	146.53	139.73 de
Saw dust as mulch	127.60	136.97	141.21	135.26 ef
Hand weeding	115.84	129.38	134.55	126.59 g
Weedy check	161.30	159.00	166.44	162.25 a
Mean	136.90 b	141.89 b	149.71 a	

LSD $_{0.05}$ value for Row spacing = 5.46, LSD $_{0.05}$ value for Treatments = 4.93, LSD $_{0.05}$ value for Interaction = 8.54

Table 5. Fruit size (cm^3) as affected by different row-row spacing and different weed control methods.

Treatment	Row spacing			Mean
	30 cm	60 cm	90 cm	
Stomp	4.53 lmno	5.53 ijk	4.50 lmno	4.85 f
Dual gold	4.77 lm	6.53 fg	4.23 mno	5.17 f
Percept	7.00 ef	9.10 b	6.17 ghi	7.42 b
White plastic as mulch	6.30 fgh	8.50 c	5.73 hij	6.84 c
Wheat straw as mulch	5.10 jkl	7.03 ef	4.60 lmn	5.57 e
Saw dust as mulch	5.50 ijk	7.80 d	5.03 kl	6.11 d
Hand weeding	7.50 de	9.93 a	6.47 fg	7.96 a
Weedy check	4.10 no	4.97 klm	3.93 o	4.33 g
Mean	5.60 b	7.42 a	5.08 b	

LSD $_{0.05}$ value for Row spacing = 0.53, LSD $_{0.05}$ value for Treatments = 0.33, LSD $_{0.05}$ value for Interaction = 0.58

Days to 1st picking: Days to 1st picking of strawberry were significantly affected by row spacing and different weed control methods while there interaction was found non-significant. Means in the data showed that maximum days to 1st picking (149.71%) were recorded for 90 cm row spacing while the lowest (136.90%) was noticed for 30 cm row spacing (Table 4). The mean data for the treatment showed that maximum (162.25%) days to 1st picking was noted for weedy check plots and minimum days to 1st picking (126.59%) was observed for hand weeding plots which was statistically at par with white plastic used as mulch (131.22%). As for the interaction of row spacing and different weed control methods, the highest value (166.44%) was recorded for 90 cm row spacing x weedy check and lowest (115.84) was noted for 30 cm row spacing x hand weeding plots. The results are in conformity with those reported by Mehla *et al*., (2000) who stated the importance of proper spacing on yield and yield component of crop. The result confirmed by Argerich *et al*., (1990), who found that herbicide application affected fruit maturity. The results supported by Rehman *et al*., (2012) who stated that weed density resulted in delayed fruit maturity as compared to weed free treatments.

Fruit size (cm^3): The analysis of variance of fruit size showed significant results for row spacing and weed control methods; their interaction was also found significant. Means in the data showed that maximum fruit size (7.42 cm^3) was recorded for 60 cm row spacing while the lowest (5.08 cm^3) was observed for 90 cm row spacing. The mean data for different weed control treatment showed that maximum (7.96 cm^3) fruit size was noted for hand weeding plots and minimum number (4.33 cm^3) was observed for weedy check plots (Table 5). As for the interaction of row spacing and different weed

control methods, the highest value (9.93 cm^3) was recorded for 60 cm row spacing x hand weeding and lowest (3.93 cm^3) was noted for 90 cm row spacing x weedy check plots. Ozer (2003) reported that fruit size determines the consumer preference. The results are greatly analogy to Kirimi *et al*., (2011) that proper spacing has a significant effect on fruit size and also reported minimum fruit size for close spacing. Our results are in line with Ram *et al*., (2009) who stated improvement in fruit size due to proper row spacing.

Conclusion and Recommendations

Strawberry is an important small fruit crop of great nutritional and medicinal value. It is grown for commercial purpose and is gaining importance among the growers of Khyber Pakhtunkhwa as a cash crop. However, strawberry production in Khyber Pakhtunkhwa is highly constrained by many factors. Farmers get lower yields mainly due to many reasons, however among them weeds are the important one.

All the treatments had significantly affected the above mentioned parameters. This experiment revealed the different row spacing and other weed control methods (herbicides, mulches and hand weeding) had a convincing effect on fresh weed biomass, days to flowering, days to fruit set, fruit size and 1st picking in comparison with weedy check plots. From data we concluded that in row spacing of 60 cm and among treatments hand weeding, percept and white plastic as mulch treated plots in strawberry was very effective. However, hand weeding plots have higher costs, which by existence of herbicides is not feasible. Thus, the results showed that herbicide percept @ 0.9 lit ha^{-1} and white plastic mulch are suggested for better results and have good economic returns in strawberry production.

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(Received for publication 22 February 2019)