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Effect of Mulches and Phosphorus on Growth and Yield of Squash (*Cucurbita pepo*)

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Abstract

This study was conducted at the Horticultural Farm of Sher-e-Bangla Agricultural University, Dhaka during October, 2015 to January, 2016 to determine the effects of mulches and phosphorus on the growth and yield of squash (*Cucurbita pepo*). The experiment consisted of two factors. Factor A: different mulches and Factor B: phosphorus (3 levels). The experiment was laid out in a Randomized Complete Block Design with three replications. Mulches and phosphorus showed significant effects on most of the parameters. In case of mulches, highest individual fruit weight (328.0 g) and fruit yield (37.0 tha^{-1}) was recorded from black polythene, whereas the lowest fruit weight (280.8 g) and fruit yield (21.5 tha^{-1}) was recorded from control. In case of phosphorus, highest individual fruit weight (300.4 g) and fruit yield (31.3 tha^{-1}) was recorded from 90 kg P_2O_5/ha, whereas the lowest fruit weight (290.4 g) and fruit yield (26.2 tha^{-1}) was recorded from control. For combination, highest individual fruit weight (338.2 g) and fruit yield (39.9 t ha^{-1}) were recorded from black polythene with 90 kg P_2O_5/ha while the lowest individual fruit weight (272.2 g) and fruit yield (19.7 t ha^{-1}) were recorded from control treatment. Black polythene mulch with 90 kg P_2O_5/ha was found suitable for squash cultivation under the condition of the study.

Keywords: Squash, mulches, phosphorus.

1. Introduction

Squash *(Cucurbita pepo* L.) belongs to the family Cucurbitaceae and is grown throughout the world in both temperate and tropical climatic zones. In Bangladesh, this crop is relatively new but is increasingly gaining high levels of economical importance both in generation of income and provision of nutritional value. Squash has various health benefits to human as well as medicinal potentials (Mohammad *et al.,* 2011). It is rich in nutrients and bioactive compounds contents such as phenolics, flavonoids, vitamins (including β-carotene, vitamin A, vitamin B2, α-tocopherol, vitamin C, and vitamin E), amino acids, carbohydrates and minerals (especially potassium), and it is low in energy content (about 17 Kcal/100 g of fresh squash) and has large amount of fiber (Tamer *et al.,* 2010). Squash is cultivated in Bangladesh during the winter season when rainfall is scanty and its growth and development is required optimum temperature within 18-25 ^{0}C (Albert, 2018). Most of the time irrigation and weed management increases the total cost of production of crops and ultimately growers can be frustrated. Mulching can reduce the water loss from the soil by evaporation which can minimize the requirement of water, suppression of weed and is thus, helpful in conserving soil moisture

for the succeeding season to produce squash successfully particularly where rainfall and irrigation facilities are limited.

Application of different mulches such as black polythene, water straw, water hyacinth, saw dust, leaves, hay, shredded bark, shells, woodchips, newspaper, cardboard etc. has been reported to have improved fruit quality (Brown and Channel l-Butcher, 2001), increased growth and subsequent yield (Brown *et at.*, 1995). Among them black polythene and water straw are economical and available in our country. Black plastic is the most popular one because it retards weed growth and warms up the soil during the spring. The black polythene mulch made the harvest earlier in addition to reducing soil water loss. Another important management practice is fertilizer. Fertilizers influenced of plant growth, yield and quality of horticultural crops, particularly color, shape, size, taste, shelf life and processing characteristics. Deficiency of soil nutrient is now considered as one of the major constraints to successful upland crop production in Bangladesh (Islam and Noor, 1982). Phosphorus is one of the important essential macro elements for the normal growth and development of plant. Phosphorous is involved in photosynthesis, respiration, energy storage and transfer, cell division, and enlargement of plant, promotes early root formation and growth, improves quality of fruits, vegetables, and grains. (Khalid, 2006). It also enhances uniform and early crop maturity, improves crop quality and increases resistance to diseases. So, the present investigation was undertaken to determine the proper mulch materials and phosphorus for better vegetative growth and yield of squash.

2. Materials and Methods

2.1 Experimental site and frame work

The soil of the experimental field belongs to the Tejgaon series under the Agro ecological Zone, Madhupur Tract (AEZ- 28) and the general soil type is Shallow Red Brown Terrace soil. The two factorial experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. The total area of the experimental plot was 178.08 m^2 with length 21.2m and width 8.4m. The total area was divided into three equal blocks. Each block was divided into 9 plots where 9 treatments combination were distributed randomly. There were 27 unit plots altogether in the experiment. The size of each plot was 1.8m × 1.8m. The experiment comprised of two factors: 3 different mulches (M_0- No mulch, M_1- Rice straw and M_2- Black polythene) and 3 levels of phosphorus (P_0 – 0 kg P_2O_5/ha, P_1 – 60 kg P_2O_5/ha and P_2 -90 kg P_2O_5/ha). There were in total 9 (3x3) treatment combinations such as M_0P_0, M_0P_1, M_0P_2, M_1P_0, M_1P_1, M_1P_2, M_2P_0, M_2P_1, M_2P_2. Urea, triple super phosphate (TSP), muriate of potash (MP), were used as a source of nitrogen, phosphorous, potassium respectively. Cow dung, urea, muriate of potash (MP), were applied at the rate of 10 tons/ha 365kg/ha, 223 kg/ha respectively following some research work above squash was done in abroad and BARI recommendation for cucurbitaceous crop (*Krishi Projuktir Hat Boi*). Phosphorous were applied as per treatment.

2.2 Polybag preparation and raising of seedlings

Polybag was prepared on 28 October 2015 for raising seedlings of squash and the size of the polybag was 8-inch length and 5-inch breadth. Loose soil was used for polybag preparation. Cow dung was mixed with soil in polybag for better growth of plant. The soil was treated by Sevin 50WP @ 5kg/ha to protect the seed and young plants from the attack of ants. Seeds were sown on 30 October 2015 in the polybag. Light watering and weeding were done several times. No chemical fertilizers were applied for raising of seedlings. Seedlings were not attacked by any kind of insect or disease. Healthy and 15 days old seedlings were transplanted into the experimental field on 21 November 2015.

2.3 Transplanting of seedlings

The seedbed was watered before uprooting the seedlings to minimize the damage of roots. Fifteen days old healthy seedlings were

transplanted at the spacing of 90 cm × 90 cm in the experimental plots on 21 November 2015. Thus the four plants were accommodated in each unit plot. Planting was done in the afternoon and light irrigation was given immediately after transplanting around each seedling for their better establishment. Watering was done up to five days until they became capable of establishing on their own root system.

2.4 Data Recording and Analysis

Data were recorded for yield and its contributing characters such as plant height (cm), number of leaves per plant, total number of male and female flower, number of marketable fruits per plant, fruit length (cm), fruit diameter (cm), fruit weight (g), yield per plant (kg), and yield per ha (t). Collected data were statistically analyzed using MSTAT-C computer package program.

3. Results and Discussion

3.1 Plant height

Application of mulching exhibited a significant influence on plant height of squash at 45 days after transplanting (DAT). At 45 DAT the tallest plant (56.38 cm) was measured from M_2 (black polythene) treatment and the shortest (47.83 cm) was recorded from control treatment M_0 (Table 1). Vegetative growth improvement might be explained in view that plastic mulches improve moisture conservation and availability, which ultimately leads to improve plant height. Odedara (2011) reported similar result in case of musk melon. Plant height of squash showed statistically significant variation due to different levels of phosphorus at 45 DAT. At 45 DAT, the tallest plant (53.63 cm) was measured from P_2 (90 kg P_2O_5/ha) treatment and the shortest (49.31 cm) was recorded from P_0 treatment (Table 1). Combined effect of different mulch materials and levels of phosphorus showed statistically significant variation in terms of plant height of squash at 45 DAT. The tallest plant height (61.23 cm) was measured from M_2P_2 (black polythene with 90 kg P_2O_5/ha) treatment combination and the shortest (47.55 cm) was recorded from M_0P_0(control) which was statistically identical to M_0P_1, M_0P_2, M_1P_0 treatment combinations at 45 DAT (Table 2). From the results, it is noticeable that mulching and phosphorus are helpful for increasing plant height of squash.

Table 1. Effect of mulch materials and phosphorus on plant height (cm) and number of leaves per plant at days after transplanting of squash

Treatment	Plant height (cm) at				Number of leaves per plant at			
	Mulch materials							
	15 DAT	25 DAT	35 DAT	45 DAT	15 DAT	25 DAT	35 DAT	45 DAT
M_0	18.80	35.43c	46.50c	47.83c	7.66	17.88c	22.44c	24.11c
M_1	23.36	36.79b	48.60b	50.06b	8.40	21.37b	25.07b	26.77b
M_2	25.03	40.48a	54.91a	56.38a	9.70	24.07a	29.89a	31.77a
Labels of phosphorus								
P_0	20.58	35.82c	48.03c	49.31c	7.88	18.99 c	22.85c	24.48 c
P_1	22.48	37.65b	49.69 b	51.33 b	8.29	21.03 b	26.33b	28.03 b
P_2	24.14	39.22a	52.29a	53.63a	9.59	23.29a	28.22a	30.14 a

In a column means having similar letter (s) are statistically similar and those having different letter (s) differ significantly at 5% level of probability

Table 2. Combined Effect of mulches and phosphorus on plant height (cm) and number of leaves per plant at days after transplanting of squash

Treatments	Plant height (cm) at				Number of leaves per plant at			
	15 DAT	25 DAT	35 DAT	45 DAT	15 DAT	25 DAT	35 DAT	45 DAT
M_0P_0	17.46e	34.67f	46.14g	47.55e	7.44	15.99f	20.00f	21.66f
M_0P_1	18.28e	35.27ef	46.05g	47.65e	7.66	17.00f	22.55e	24.22e
M_0P_2	20.67d	36.34e	47.32f	48.28e	7.89	20.66de	24.78cd	26.44d
M_1P_0	21.51d	35.45ef	46.52fg	48.06e	7.78	19.22e	23.55de	25.11e
M_1P_1	23.43c	36.70d	48.97e	50.76d	8.66	21.33d	25.55c	27.22cd
M_1P_2	25.16 b	38.22 c	50.31d	51.37cd	8.77	23.55bc	26.11c	28.00c
M_2P_0	22.79c	37.34d	51.42c	52.33c	8.44	21.78cd	25.00cd	26.66d
M_2P_1	25.72b	40.99b	54.04 b	55.59 b	8.55	24.78ab	30.89b	32.66b
M_2P_2	26.59 a	43.12a	59.24 a	61.23 a	12.11	25.66 a	33.77 a	36.00 a

In a column means having similar letter (s) are statistically similar and those having different letter (s) differ significantly at 5% level of probability

Table 3. Effect of mulches and phosphorus on yield and yield attributing parameter of squash

Treatment	Number of male flowers per plant	Number of female flowers per plant	Number of marketable fruits per plant	Length of fruit (cm)	Diameter of fruit (cm)	Weight of individual fruit (g)	Fruit yield per plant (kg)
Mulch Materials							
M_0	16.85c	13.92c	6.14c	17.67c	4.54c	280.83b	1.76c
M_1	19.00 b	15.77 b	8.07 b	19.42b	5.57b	281.84b	2.34 b
M_2	20.92 a	18.29 a	9.85 a	21.15a	7.11a	328.00 a	3.07 a
Labels of phosphorus							
P_0	17.66c	15.22 b	7.18c	18.86c	5.34c	290.42b	
P_1	18.74b	16.07 ab	8.11b	19.36b	5.68b	300.43a	2.39b
P_2	20.37a	16.70 a	8.78a	20.02a	6.19a	299.82a	2.58a

In a column means having similar letter (s) are statistically similar and those having different letter (s) differ significantly at 5% level of probability

3.2 Number of leaves per plant

Number of leaves per plants was significantly influenced by different mulching at 45. At 45 DAT, maximum numbers of leaves (31.77) plant^{-1} were observed from M_2 (black polythene) treatment and minimum numbers of leaves (24.11) plant^{-1} were recorded from M_0 treatment (Table 1). The extended retention of moisture and availability of moisture also leading to higher uptake of nutrient for proper growth and development of plants, resulted maximum number of leaves, as compared to control. Aniekwe (2015), Roudan and Vahid (2015) found similar result in case of squash. Significant variation was recorded due to different level of phosphorus intense of number of leaves per plant at 45 DAT. Maximum numbers of leaves (30.14) plant^{-1} were found from P_2 (90 kg P_2O_5/ha) treatment and minimum numbers of leaves (24.48) plant^{-1} were found from P_0 treatment at 45 DAT (Table 1). This result was conformity with result found by Narke *et al.* (2015) and

Naik (2016) in case of squash. Different mulching and different levels of phosphorus showed significant differences due to their combined effect on number of leaves per plant of squash at 45 DAT. At 45 DAT, the maximum numbers of leaves (36.00) plant^{-1} were observe in M_2P_2 (black polythene with 90 kg P_2O_5/ha) treatment combination and minimum numbers of leaves (21.66) plant^{-1} were observed in M_0P_0 treatment combination (Table 2). It was revealed that the combined effect of black polythene and 90 kg P_2O_5/ha increased number of leaves plant^{-1} of squash of M_0P_0 (control) which was closely followed by M_0P_1, M_1P_1 treatment combination.

3.3 Number of male flowers per plant

Number of male flowers per plant showed statistically significant variation due to different mulching of squash. The maximum number of male flowers (20.92) plant^{-1} was recorded from M_2 (black polythene) treatment, whereas the minimum number of male flowers (16.85) plant^{-1} was found from M_0 (control) treatment (Table 3). Mahadeen (2014) also reported similar findings from his experiment. There was significant effect of different levels of phosphorus on the number of male flowers per plant. The highest number of male flowers (20.37) plant^{-1} was found from P_2 (90 kg P_2O_5/ha) treatment while the lowest number of male flowers (17.66) plant^{-1} was found from P_0 (control) treatment (Table 3). Sahar *et al.* (2005) also observed the similar findings in case of squash. Combined effect of different mulching and levels of phosphorus showed statistically significant variation in terms of number of male flowers per plant of squash. The maximum number of male flowers (22.22) plant^{-1} was observed from M_2P_2 (black polythene with 90 kg P_2O_5/ha) treatment combination and the minimum number of male flowers (16.11) plant^{-1} was recorded from M_0P_0 (control) treatment combination, which was statistically similar to M_0P_1 treatment combination (Table 4).

3.4 Number of female flower per plant

A significant variation due to the effect of mulching was found on number of female flowers per plant. The highest number of female flowers (18.29) plant^{-1} was recorded in M_2 (black polythene) treatment and the lowest number of female flowers (13.92) plant^{-1} was recorded from M_0 (control) treatment (Table 3). The results indicated that maximum female flowers in number were produced by the application of black polythene compared with the control. Mahadeen (2014) reported similar findings from his experiment in case of squash. Effect of different levels of phosphorus was also statistically significant on number of female flowers plant^{-1}. The maximum number of female flowers (16.70) plant^{-1} was recorded from P_2 (90 kg P_2O_5/ha) treatment and the minimum number of female flowers (15.22) plant^{-1} was recorded from P_0 (control) treatment (Table 3). This might be due to the fact that phosphorus fertilizer promoted femaleness in plants. Umamaheswarappa *et al.* (2005) reported the similar results from their earlier experiments in case of squash. Number of female flowers per plant varied significantly due to the combined effect of different mulching and different levels of phosphorus. The highest number of female flowers (19.11) plant^{-1} was recorded from the treatment combination M_2P_2 (black polythene with 90 kg P_2O_5/ha) which was closely followed by M_2P_1 (18.55) and the lowest number of female flowers (13.22) plant^{-1} was recorded from the treatment combination M_0P_0 (Table 4).

3.5 Number of marketable fruits per plant

Different mulch materials showed a statistically significant variation on number of marketable fruits per plant. Marketable fruits per plant showed a gradual increasing trend for different mulching comparing the control. The maximum (9.85) marketable fruits plant^{-1} in number were recorded from M_2 (black polythene) treatment and the minimum (6.14) marketable fruits plant^{-1} were recorded in M_0 (Table 3). Mutetwa and Mtaita (2014) stated that marketable fruit yield significantly improved by the use of a silvery-grey colored plastic mulch compared to the blue colored and wheat straw mulch. Number of marketable fruits per plant varied significantly due to different levels of phosphorus. The maximum (8.78) number of marketable fruits

plant^{-1} was recorded in application of P_2 (90 kg P_2O_5/ha) treatment and the minimum (7.18) number of marketable fruit plant^{-1} in number were recorded in P_0 (control condition). The results indicated that maximum fruits per plant were produced by the application of phosphorus than the control with ensuring the better yield of squash. Mulching and phosphorus showed a statistically significant variation in consideration of fruits per plant in number. The maximum (10.22) number of marketable fruit plant^{-1} was recorded in the treatment combination M_2P_2 (black polythene with 90 kg P_2O_5/ha) and the minimum (5.11) was recorded in the treatment combination M_0P_0 (control condition) (Table 4). The results indicated that combination of mulching and phosphorus ensures the optimum condition for the growth and development of squash and the ultimate result is the maximum marketable fruits plant^{-1}.

3.6 Length of fruit (cm)

Statistically significant variation was recorded in terms of length of fruit due to different mulching. The maximum (21.15 cm) fruit length was recorded from M_2 (black polythene) treatment (Table 3) and the minimum (17.67 cm) length of fruit was recorded in M_0 (control) (Table 3). The researchers indicated that plants under polyethylene mulch produce larger fruit and have higher fruit yield per plant because of the better plant growth that due to favorable hydro-thermal regime of soil and complete weed free environment. Bhutia (2011) found that fruit length was recorded highest in black plastic mulch than green plastic mulch. Phosphorus had significant effect on length of fruit. The maximum (20.02 cm) length of fruit was recorded from P_2 (90 kg P_2O_5/ha) treatment and the minimum (18.86 cm) length of fruit was recorded in case of P_0 (control) treatment (Table 3). Naik and Srinivas (1992) found similar result in case of squash. Combined effect of mulching and phosphorus showed a statistically significant variation in length of fruit. The maximum (21.79 cm) fruit length was recorded in the treatment combination of M_2P_2 (black polythene with 90 kg P_2O_5/ha) which was closely followed by M_2P_1 and the minimum (17.12 cm) was recorded in the treatment combination of M_0P_0 (control), which was closely followed by M_0P_1 shown in Table 4.

Table 4. Combined effect of mulches and phosphorus on yield and yield attributing parameter of squash

Treatments	Number of male flowers per plant	Number of female flowers per plant	Number of marketable fruits per plant	Length of fruit (cm)	Diameter of fruit (cm)	Weight of individual fruit (g)	Fruit yield per plant (kg)	Fruit yield per hectare (t)
M_0P_0	16.11g	13.22 g	5.11e	17.12h	4.23 f	272.24d	1.60h	19.73h
M_0P_1	16.67fg	13.89fg	6.44d	17.73gh	4.44f	280.75cd	1.77gh	21.83g
M_0P_2	17.78de	14.67efg	6.89d	18.16fg	4.94e	289.50bcd	1.90g	23.18g
M_1P_0	17.22ef	15.22def	6.89d	18.89ef	5.07de	280.88 cd	2.15f	25.14 f
M_1P_1	18.66d	15.77cde	8.11c	19.27de	5.53d	292.99bcd	2.32e	28.08 e
M_1P_2	21.11b	16.33cd	9.23b	20.11cd	6.11c	271.70d	2.54d	30.80d
M_2P_0	19.67c	17.22bc	9.55b	20.58bc	6.72 b	318.11bc	2.84c	34.01c
M_2P_1	20.89b	18.55ab	9.78ab	21.09 ab	7.08ab	327.55ab	3.08b	37.31b
M_2P_2	22.22a	19.11a	10.22a	21.79a	7.53a	338.26 a	3.29a	39.95 a

In a column means having similar letter (s) are statistically similar and those having different letter (s) differ significantly at 5% level of probability.

3.7 Diameter of fruit (cm)

Diameter of fruit showed a significant variation in relation with different mulch materials. The lowest (4.54 cm) average diameter of fruit was recorded in M_0 (control) treatment and the highest (7.11 cm) average diameter of fruit was recorded in M_2 (black polythene) treatment (Table 3). Deoraoji and Chandrashekhar (2003) found that fruit characters like diameter of fruit, weight of fruit and fruits per vine showed significant results under grass mulch and black polyethylene mulch in case of squash. The variation in diameter of fruit among the different levels of phosphorus were found to be statistically significant. the maximum (6.19 cm) diameter of fruit was recorded from P_2 (90 kg P_2O_5/ha) treatment and the minimum (5.34 cm) was recorded in P_0 (control) treatment (Table 3). It was observed that the combined effect of different mulching and levels of phosphorus on diameter of fruit was statistically significant. The highest (7.53 cm) average diameter of individual fruit was recorded from the treatment combination M_2P_2 (black polythene with 90 kg P_2O_5/ha) which was statistically similar to M_2P_1 treatment combination and the lowest (10.97 cm) was recorded from the treatment combination of M_0P_0 (control) which was statistically identical to M_0P_1 treatment combination (Table 4)

3.8 Individual fruit weight (g)

Mulching showed a significant influence on fruit weight of squash. The maximum fruit weight (328 g) was measured from M_2 (black polythene) treatment and minimum fruit weight (380.83 g) was recorded from M_0 (control) treatment which was statistically identical to M_1 treatment (Table 3). It was revealed that the fruit weight increased with mulching application. Mulching retain soil moisture that helps to increase fruit weight of squash. Mahadeen (2014) also found that mulches gave higher fruit weight in squash then non-mulched plots. Conformity result was found by Khan *et al.* (2015) in case of sponge gourd. The analysis of variance given in table 3 revealed that the effect of different levels of phosphorus on weight of individual fruits was statistically influenced. The highest individual fruit weight (300.43 g) was found from P_1 (90 kg P_2O_5/ha) treatment which was statistically identical to P_2 treatment, while the lowest individual fruit weight (290.42 g) was found from P_0 (control) treatment (Table 3). Similar result was found in case of squash by Sahar *et al*. (2005). There was significant combined effect of different mulching and levels of phosphorus on the weight of individual fruit. The maximum (338.26 g) fruit weight was recorded in the treatment combination of M_2P_2 (black polythene with 90 kg P_2O_5/ha), which was statistically similar to M_2P_1 and the minimum (272.24 g) was recorded in the treatment combination of M_0P_0 (control) shown in Table 4. The results indicated that combination of mulching and phosphorus ensures the optimum condition for the growth and development of squash and the ultimate result is the maximum fruit weight.

3.9 Fruit yield per plant (kg)

Fruit yield per plant was significantly influenced by mulching. The highest fruit yield (3.07 kg) plant^{-1} was recorded from M_2 (black polythene) treatment whereas the lowest fruit yield (1.76 kg) plant^{-1} was found from M_0 (control) treatment (Table 3). Higher yield might be due to sufficient soil moisture near the root zone that ensures better plant growth as expressed in vigorous plant growth. Parmer *et al.* (2013) found similar result in case of musk melon and Bhutia (2011) in case of bottle gourd. Levels of phosphorus varied significantly in terms of fruit yield per plant of squash. The highest fruit yield (2.58 kg) plant^{-1} was found from P_2 (90 kg P_2O_5/ha) treatment, while the lowest fruit yield (2.20 kg) plant^{-1} was found from P_0 (control) treatment (Table 3). Phosphorus application increased the fruits yield parameters of the crop which may be attributed to the ability of the phosphorus fertilizer to promote vigorous growth, increased meristematic and physiological activities in the plant due to nutrients supply and improvement in the soil properties, thereby resulting in the synthesis of more photo-assimilates which is used in producing fruits. Sahar *et al*. (2005) also found the similar response of squash to phosphorus fertilizer in their field experiment.

Combined effect of different mulching and levels of phosphorus showed statistically significant variation in terms of fruit yield per plant of squash. The highest fruit yield (3.29 kg) plant^{-1} was observed from M_2P_2 (black polythene with 90 kg P_2O_5/ha) treatment combination and the lowest fruit yield (1.60 kg) plant^{-1} was recorded from M_0P_0 (control) treatment combination which was statistically similar to M_0P_1 treatment combination (Table 4).

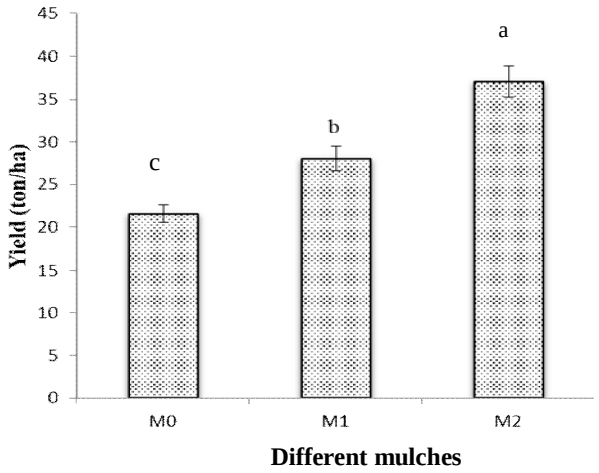

Figure 1. Effect of mulches on fruit yield per hectare (t) of squash **(**M_0: Control, M_1: Rice straw, M_2: Black polythene)

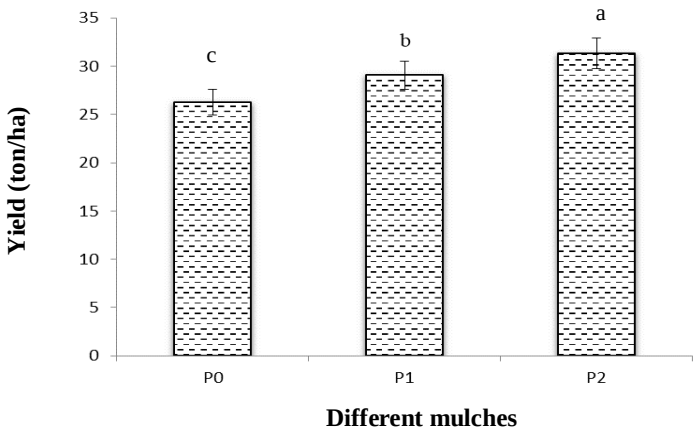

Figure 2. Effect of Phosphorus on yield per hectare (t) of squash (P_0:0 kg P_2O_5/ha, P_1: 60 kg P_2O_5/ha, P_2: 90 kg P_2O_5/ha)

3.10 Fruit yield per hectare (t)

A statistically significant variation was recorded in terms of yield per hectare for different mulching. The maximum (37.09 t) yield ha^{-1} was recorded from M_2 (black polythene) treatment (Fig. 1) and the minimum (21.58 t) yield ha^{-1} was recorded in M_0 control condition. Qadir (1992) found that polythene mulches resulted higher fruit yield as compared to straw mulched and non-mulched plants. The use of plastic mulch promotes changes in the microclimate of the plant, favoring growth and vigor, production and yield of plants. Khan et al. (2015) found similar result in case of sponge gourd, Odedara (2011) in case of musk melon. Different levels of phosphorus varied significantly in terms of fruit yield per hectare of squash. The highest yield was observed from P_2 (31.32 t) ha^{-1} treatment and lowest yield was observed from P_1 (26.29 t) ha^{-1} treatment (Fig. 2). Sahar *et al*. (2005) reported the similar results from their earlier experiment.

The analysis of variance given in table 4, revealed that the combined effect of different mulching and levels of phosphorus on fruit yield per hectare was found to be statistically significant. The maximum (39.95 t) yield ha^{-1} was recorded in the treatment combination of M_2P_2 (black polythene with 90 kg P_2O_5 /ha) and the minimum (19.73 t) was recorded in the treatment combination of M_0P_0 control condition (Table 4). The results indicated that combination of mulching and phosphorus ensures the optimum condition for the growth and development of squash and the ultimate results is the maximum yield per hectare. Furthermore, increased fruit yield per plant might have contributed towards increased overall fruit yield.

4. Conclusions

It may be concluded that use of black polythene mulch and phosphorus at 90 kg P_2O_5/ha would be suitable for optimum vegetative growth and yield of squash compare to other treatments.

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