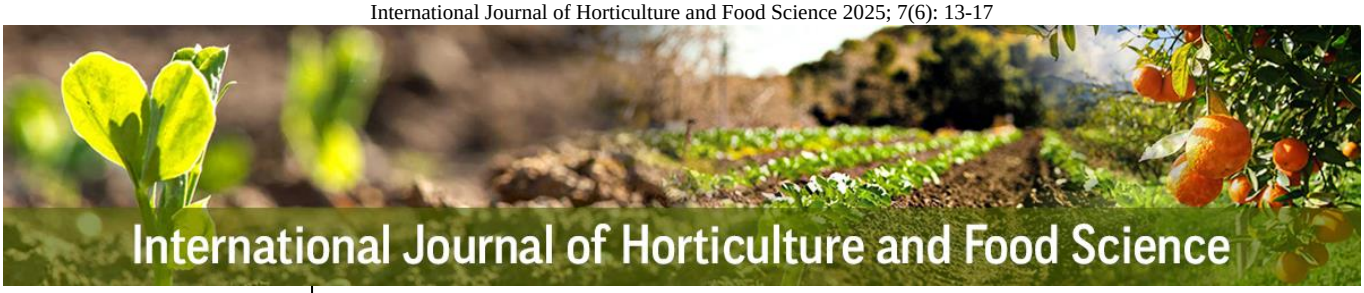

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Impact of mulching materials and fertigation levels on papaya (*Carica papaya* L.) cv. Red Lady under protected cultivation

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Abstract
The experiment carried out to find out the "Impact of mulching materials and fertigation levels on papaya (*Carica papaya* L.) cv. Red Lady under protected cultivation was carried out at the Instructional Farm (Horticulture), Career Point University, Alaniya, Kota during 2024-2025. The experiment was laid out in Factorial Randomized Block Design with thrice replication including twelve treatment combinations, comprising like Factor- A treatments N and K % is F_1-120 %, F_2 100%, F_3-80%. Factor -B split treatments S_1-10 and S_2-20 Factor -C M_1- Organic mulch and M_2- Black polythene mulch

The application of fertilizer on productivity was found most effective improve in papaya crop. The highest plant height (115.41, 153.13 and 190.84 cm), leaves was found to be maximum (31.62, 55.13 and 65.97) at 150, 200 and 250 DAT, fruit weight was found to be maximum (1.09 kg), fruit yield per plant found to be maximum fruit (22.79 kg/ plant, total soluble solids was found to be higher (10.70 ^{0}brix), maximum ascorbic acid (41.26 mg/100g) under all treatment F_2 (fertilizer level 100%).

Fertilization split significantly height growth period on all the observation the increase in plant height was found to be maximum (115.11, 156.66 and185.68 cm), number of leaves was found to be maximum (28.54, 50.60 and 64.53), at 150, 200 and 250 DAT The maximum fruit weight (0.980 g), fruit yield maximum (20.14 kg/plant) maximum total soluble solids (10.05 ^{0}brix), ascorbic acid was found to be maximum (38.06 mg/100g), were observed in Fertilization split 20

The use of black polythene in plant height was found to be maximum (123.81 cm) at 150DAT, number of leaves maximum (27.85 and 49.88 at 150 and 200 DAT be maximum fruit weight 0. 980 kg), under treatment M_2 (Black polythene mulch). The fruit yield was found to be maximum (19.84 kg/plant), maximum total soluble solids (10.03 ^{0}brix), maximum ascorbic acid (37.62 mg/100g) under treatment M_2 (Black polythene mulch).

Keywords: Mulching materials and fertigation levels papaya

Introduction
After mango, banana, and citrus, papaya (*Carica papaya* L.) is one of India's most significant tropical fruit crops. It is the only species cultivated for edible fruits and is a member of the Caricaceae family. (Chadha, 1992) [4]. As a polygamous plant, papayas have three basic gender types: pistillate, hermaphrodite, and staminate. The pistillate form is stable relative to the other forms. The papaya tree is an evergreen with a softwood stem that is hollow and unbranched. With their long petioles, the leaves resemble palms.

Tropical climates with best irrigation are ideal for papaya cultivation. Fruit of papaya will ready for harvest after 150-160 days of flowering, the ripe fruits are ready for harvest, and they are still accessible for around four to five months after that. With the right care, it produces 70-80 tonnes of fruits per acre. It is necessary to provide enough light, heat, and water for papayas to produce more nutrients.

Mulching is a crucial component of precision farming and is regarded as one of the best methods a farmer can use to keep his property in good condition. Mulching is the process of applying synthetic or organic mulch to the soil surface surrounding plants to promote plant development and productive crop production. Mulches increase soil structure, control soil temperature, stop moisture loss, and shield soil from erosion. (Bakshi *et al*., 2014) [3].

Good scope of increasing productively of papaya by adopting both drip irrigation with

fertigation of split fertilizer application and black polythene mulching. This has been already proved in different crops and the extent of an increase in yield varies from 12 to 32 per cent along with considerable savings of water and fertilizer. Further, mulching along with drip has been found to be more beneficial in increasing productivity as Tank *et al*. (2011) [16].

Materials and Methods

The study was carried out during the *kharif* season at Research Farm Department of Horticulture, School of Agriculture Science, Career Point University Kota, India. Variety used in research Red Lady under protected cultivation. Spacing 1.8X1.8m used during experiment. The site is situated in Humid South Eastern Plain Zone V which falls in south eastern part of Rajasthan and covers geographical area of 26.43 lakh ha and represents 7.71 per cent of the total geographical area of the state. The zone is located between $23^0$45´ and $26^0$33´ North latitudes and $75^0$27´ and $77^0$26´ East longitudes.

- **Observation recorded**

1. Plant height (cm) at 150, 200 and 250 days after transplanting
2. Leaves per plant at 150, 200 and 250 days after transplanting
3. Fruit weight (kg)
4. Fruit yield (kg/plant)
5. Total soluble solids (^{0}Brix)
6. Ascorbic acid (mg/100g)

Results

- **Plant Height (cm)**

Effect of fertilizer

A reveals that the height of papaya plant maximum plant height (115.41, 153.13 and 190.84 cm) at 150, 200 and 250 DAT, under treatment F_2 (fertilizer level 100%). The minimum plant height (107.05, 134.61 and 175.46 cm) at 150, 200 and 250 DAT was recorded in F_3 (80 %).

Effect of fertilization split

A data presented to reveals that the significantly height growth period on all the observation the increase in plant height was found to be maximum (115.11, 156.66 and185.68 cm) at 150, 200 and 250 DAT, under treatment S_2 (fertilization split 20) The minimum plant height (109.54, 142.28 and 180.93 cm) at 150, 200 and 250 DAT was recorded in S_1 fertilization split 10)

Effect of mulching

A perusal of data reveals that the height growth period on all the observation the increase in plant height was found to be highest (123.81 cm) at 150DAT, under treatment M_2 (Black polythene mulch). The lowest plant height (100.84 cm) at 150DAT was recorded in M_1 (Organic mulch).

- **Number of leaves**

Effect of fertilizer

A reveals that the number of leaves of papaya plant cv. Rad Lady changed with the advancement of the growth period on all the observation the increase in number of leaves was found to be maximum (31.62,55.13 and 65.97) at 150, 200 and 250 DAT, under treatment F_2 (fertilizer level 100%). The minimum number of leaves (23.15, 44.02 and 61.82) at 150, 200 and 250 DAT was recorded in F_3 (80 %).

Effect of fertilization split

A data examined to reveals that the significantly height of papaya plant cv. Rad Lady changed with the advancement of the growth period on all the observation the increase in number of leaves was found to be maximum (28.54, 50.60 and 64.53) at 150, 200 and 250 DAT, under treatment S_2 (fertilization split 20) The minimum number of leaves (26.17, 47.62 and 63.14) at 150, 200 and 250 DAT was recorded in S1 (fertilization split 10)

Effect of mulching

A data reveals that the papaya plant cv. Rad Lady changed with the advancement of the growth period on all the observation the increase in number of leaves was found to be maximum (27.85 and 49.88) at 150 and 200 DAT, under treatment M_2 (Black polythene mulch). The minimum number of leaves (26.85 and 48.34) at 150 and 200 DAT was recorded in M_1 (Organic mulch).

- **Fruit weight (kg)**

Effect of fertilizer

A perusal of reveals that the fruit weight of papaya plant cv. Rad Lady changed with the advancement of all the observation the increase in fruit weight was found to be maximum (1.09 kg), under treatment F_2 (fertilizer level 100%). The minimum fruit weight (0.760 kg) was recorded in F_3 (80 %).

Effect of fertilization split

A data examined to reveals that the significantly height of papaya plant cv. Rad Lady. The maximum fruit weight (0.980 g), under treatment S_2 (fertilization split 20). While minimum fruit weight (0.940 kg) was recorded in S_1 (fertilization split 10)

Effect of mulching

A data reveals that the papaya plant cv. Rad Lady changed with the advancement of the growth period on all the observation the increase in fruit length was found to be maximum fruit weight 0. 980 kg) under treatment M_2 (Black polythene mulch). The minimum fruit weight (0. 940 kg) was recorded in M_1 (Organic mulch).

- **Fruit yield plant^{-1} (kg)**

Effect of fertilizer

The data reveals that the fruit yield plant^{-1} found to be maximum fruit (22.79 kg/ plant), under treatment F_2 (fertilizer level 100%). The minimum fruit yield plant^{-1} (116.60 kg/plant) was recorded in F_3 (80 %).

Effect of fertilization split

A data examined to reveals that the significantly fruit yield plant^{-1} was found to be maximum (20.14 kg/plant), under treatment S_2 (fertilization split 20). The minimum fruit yield plant^{-1} (18.87 kg/plant) was recorded in S_1 (fertilization split 10).

Effect of mulching

A data reveals that the fruit yield plant^{-1} found to be highest (19.84 kg/plant), under treatment M_2 (Black polythene mulch). The lowest yield plant^{-1} (19.17 kg/plant) was recorded in M_1 (Organic mulch).

- **Total soluble solids (^{0}Brix)**

Effect of fertilizer

Increase in total soluble solids was found to be higher (10.70 ^{0}brix), under treatment F_2 (fertilizer level 100%). The lowest total soluble solids (8.70 ^{0}brix) was recorded in F_3 (80 %).

Effect of fertilization split

A data examined to reveals that the significantly of papaya plant cv. Rad Lady. The maximum total soluble solids (10.05 ^{0}brix), under treatment S_2 (fertilization split 20). While minimum total soluble solids (9.51 ^{0}brix) was recorded in S_1 (fertilization split 10)

Effect of mulching

A data reveals that the papaya plant cv. Rad Lady changed with the advancement of the all the observation the increase in TSS was found to be maximum total soluble solids (10.03 ^{0}brix), under treatment M_2 (Black polythene mulch). The minimum total soluble solids (9.53 ^{0}brix) was recorded in M_1 (Organic mulch).

- **Ascorbic acid (mg/100g)**

Effect of fertilizer

The data reveals that the found to be higher ascorbic acid (41.26 mg/100g), under treatment F_2 (fertilizer level 100%). The lower ascorbic acid (33.35 mg/100g)) was noted in F_3 (80 %).

Effect of fertilization split

A data examined to reveals that the significantly ascorbic acid was found to be maximum (38.06 mg/100g), under treatment S_2 (fertilization split 20). The minimum ascorbic acid (36.22 mg/100g)) was recorded in S_1 (fertilization split 10).

Effect of mulching

A data reveals that the significantly was found to be maximum ascorbic acid (37.62 mg/100g), under treatment M_2 (Black polythene mulching). The minimum ascorbic acid (36.67 mg/100g)) was recorded in M_1 (Organic mulch).

Discussion

- **Growth characters**

Effect of fertigation

Therefore, consistent, long-term food availability aided in the synthesis and deposition of photoassimilates. Better growth, fruit bud differentiation (FBD), early blooming, and a notable increase in floral yield might have resulted from this. Having enough nutrients available to papaya plants may have improved flower bud differentiation and raised papaya flower output. (Agrawal *et al*., 2010; Jeyakumar *et al*., 2010; Yadav *et al*., 2011) [2, 8, 17]. These findings are in conformity with the results of present experiment. Split application of nutrients through fertigation has proved successful practice in better physiological efficiency of the plants (Syvertsen and Smith, 1996; Gnanamurthy and Manickasundram, 2001; Agrawal *et al*., 2010 and Jeyakumar *et al*., 2001) [15, 6, 2, 8].

Effect of mulch

Better root activity and soil moisture conservation may be the causes of the mulching treatments, which also slowed down the rate of evaporation. By altering the microclimate by preserving more moisture through decreased evaporation, adjusting soil temperature, suppressing weeds, and so saving irrigation water, mulching clearly improves plant development.

The greater effectiveness of polythene mulch in increasing the growth components is due to the fact that it deprives the germinating weeds form sunlight for further growth and absorbs higher quantum of sun rays due to its black colour and increased soil temperature, thereby, resulting in death of germinating seedling of winter weeds. These results are in conformity with the findings of Mirza *et al*. (2019) [12] in papaya, Bakshi *et al*. (2014) [3], Gupta and Acharya (1993) [7], Kher *et al*. (2010) [10], Dutta and Majumder (2009) [5] and Khan *et al*. (2013) [9] in guava.

- **Yield attributes and yield**

Effect of fertigation

The results of Kumar *et al*. (2006) [11] and Yadav *et al*., 2011) [17] in papaya yield are in agreement with the present experiment. The results are in agreement with Shirgure *et al*. (2001) [13] in sweet orange. Increased nitrate levels in the plant due to a lack of nitrate to protein conversion can have unfavourable impacts including a higher risk of illness and lower-quality product. One possible explanation for the noticeable impact of nitrogen on fruit size (cm) and fruiting is that absorbed.

The nitrogen fertigation increased the yield of various fruit crops like Acid lime (Shirgure *et al*., 2001) [13], Slow and frequent watering eliminated wide fluctuation of soil moisture under drip irrigation, which resulted in better growth and yield.

Effect of mulching

Improved soil microclimate, weed-free conditions, low evaporation, and increased moisture availability in the root zone may have contributed to better nutrient uptake by the plant, resulting in early and better vegetative and flowering growth. This, in turn, may have improved the rate of photosynthesis and the translocation of food synthesised from leaves to fruits, resulting in early harvesting and more fruits per plant under black plastic mulch. Additionally, it is in charge of less fertiliser leaching, more efficient use of water, and a rise in organic matter, which results in more flowers per plant and a higher percentage of fruit set, which in turn increases the number of fruits per plant and raises the yield per plant.

Increased uptake of nutrients and moisture from a favourable soil environment may have produced enough carbohydrates in the leaves for translocation to sink for better fruit filling, which led to increased fruit size and yield attributes. Higher absorption of nutrients and moisture from the soil by the growing number of superficial roots may also have contributed to the increase in fruit weight.

These results are in conformity with the findings of Mirza *et al.* (2019) [12] in papaya, Adnan *et al.* (2017) [1], Kher *et al*. (2010) [10], Kumar *et al*. (2018).

- **Quality parameters**

The increasing sugar content of fruits might have been due to the process of photosynthesis, which ultimately led to the accumulation of large amount of carbohydrates and increased the sugar content of fruits weigh Agrawal *et al*., 2010, Singh *et al*., 2004) [2].

Table 1: Effect of fertigation and mulching on plant height (cm) of papaya cv. Red Lady

Treatments	Plant height (cm)		
Fertilizers N and K %	**At 150 DAT**	**At 200 DAT**	**At 250 DAT**
F_1-120%	114.52	145.68	183.61
F_2-100%	115.41	153.13	190.84
F_3-80%	107.05	134.61	175.46
SEm±	2.347	0.948	1.119
CD at 5 %	6.883	2.780	3.283
Fertiligation split			
S_1-10	109.54	142.28	180.93
S_2-20	115.11	146.66	185.68
SEm±	1.916	0.774	0.914
CD at 5 %	5.620	2.270	2.681
Mulching treatments			
M_1-Organic mulch	100.84	143.50	182.27
M_2-Black polythene mulch	123.81	145.44	184.34
SEm±	1.916	0.774	0.914
CD at 5 %	5.620	NS	NS
CV %	7.24	2.27	2.12

Table 2: Effect of fertigation and mulching on number of leaves of papaya cv. Red Lady

Treatments	Number of leaves		
Fertilizers N and K %	**At 150 DAT**	**At 200 DAT**	**At 250 DAT**
F_1-120%	27.29	48.18	63.71
F_2-100%	31.62	55.13	65.97
F_3-80%	23.15	44.02	61.82
SEm±	0.180	0.343	0.458
CD at 5 %	0.528	1.007	1.343
Fertiligation split			
S_1-10	26.17	47.62	63.14
S_2-20	28.54	50.60	64.53
SEm±	0.147	0.280	0.374
CD at 5 %	0.431	0.822	1.096
Mulching treatments			
M_1-Organic mulch	26.85	48.34	63.45
M_2-Black polythene mulch	27.85	49.88	64.21
SEm±	0.147	0.280	0.374
CD at 5 %	0.431	0.822	NS
CV %	2.28	2.42	2.48

Table 3: Effect of fertigation and mulching on Dyads taken to first flowering, Fruit diameters and length of papaya cv. Red Lady

Treatments	Fruit weight (kg)	Fruit yield per plant (kg)
Fertilizers N and K %		
F_1-120%	1.04	19.13
F_2-100%	1.09	22.79
F_3-80%	0.760	16.60
SEm±	0.009	0.160
CD at 5 %	0.025	0.469
Fertiligation split		
S_1-10	0.940	18.87
S_2-20	0.980	20.14
SEm±	0.007	0.130
CD at 5 %	0.021	0.383
Mulching treatments		
M_1-Organic mulch	0.940	19.17
M_2-Black polythene mulch	0.980	19.84
SEm±	0.007	0.130
CD at 5 %	0.021	0.383
CV %	3.12	2.84

Table 4: Effect of fertigation and mulching on quality of papaya cv. Red Lady

Treatments Fertilizers N and K %	Total soluble solids (^{0}Brix)	Ascorbic acid (mg/100g)
F_1-120%	9.94	36.82
F_2-100%	10.70	41.26
F_3-80%	8.70	33.35
SEm±	0.083	0.293
CD at 5 %	0.244	0.861
Fertiligation split		
S_1-10	9.51	36.22
S_2-20	10.05	38.06
SEm±	0.068	0.240
CD at 5 %	0.199	0.703
Mulching treatments		
M_1-Organic mulch	9.53	36.67
M_2-Black polythene mulch	10.03	37.62
SEm±	0.068	0.240
CD at 5 %	0.199	0.703
CV %	2.95	2.74

Conclusion

In the light of results summarized above, it may be concluded that for higher growth yield and quality grain yield found Fertilizer level 100 %+ Fertilization split 20+ Black polythene mulch should preferred over other combination under protected cultivation of papaya. The observations are based on one season data, to get more precise information, it is suggested that the experiment.

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