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Effect of different irrigation and fertilizer levels on growth, yield and cost economics of papaya (*Carica papaya* L.) *cv.* red lady under open field conditions

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Abstract
An experiment was carried out to study the growth, yield and cost economics of papaya (*Carica papaya* L.) *cv.* Red lady as influenced by different irrigation and fertilizer levels. This experiment was conducted at PFDC (Precision farming development center), Department of Horticulture, UAS, GKVK, Bengaluru during 2018-19 and 2019-20. The experiment was laid out with twelve different treatments replicated thrice. The spacing followed was 1.8 m x 1.8 m. The results revealed that treatment T12 - I4F3 at 60%, 90% and 120% E pan(mm/day) + 125 RDF was noticed highest vegetative and reproductive parameters like plant height, stem girth, number of flowers, number of fruits, fruit weight, fruit yield per plant, fruit yield per hector and cost economics was showed significantly highest. This was followed by T11- I4F2 at 60%, 90% and 120% E pan(mm/day) + 100% RDF, whereas the least vegetative, yield parameter and also lesser cost benefit ratio was observed in T1 - I1F1 30%,50% and 60% E pan(mm/day) +75% RDF at 90, 180, 270, 360, 450 and 540 days after transplanting under open field condition respectively.

Keywords: Papaya, drip irrigation, growth parameters, yield parameter, cost economics, RDF

Introduction
Papaya (*Carica papaya* L.) is a fast growing, short lived, semi woody and herbaceous tree. It is grown commercially for its fruits which are consumed both as fresh fruit and processed products grows to a height of 10-12 feet. Next to mango and pineapple papaya is most cultivated fruit in the world consider to tropical climate, which occupies 15.36% of total tropical fruit production in the world.

Papaya is largely cultivated in Australia, Hawaii, India, Sri Lanka, Myanmar, Taiwan, Brazil, Peru, Puerto Rico, Florida, Texas, California, South Africa and Kenya. In India, it is successfully grown all over the country and available round the year. This occupies 1.8 per cent of the total fruit crop area and contribute 6.3 per cent of total fruit production in India. This is cultivated in an area of 133.36 thousand hectares with a production of 5639.30 thousand MT. The average productivity is 42.3 tons per hectare (Anon., 2018) [3]. The important papaya growing states in India are Andhra Pradesh, Gujarat, Maharashtra, Karnataka, Madhya Pradesh, Bihar, West Bengal, Tamil Nadu, Kerala, Assam and Rajasthan, where ideal climatic conditions are available for its growth and production.

Global papaya production has increased significantly over the last few years mainly due to increased production from India. Being a tropical fruit tree, it successfully thrivies in several states of India. Indian domestic demand for papaya has been increasing strongly because of considering it as a healthy fruit in a human diet. This awareness among the large population of India and people have further added to the increased demand and production for healthier food product.

The cultivated area under this crop in Karnataka State is 5,800 hectares with the total production of 4, 19, 300 metric tonnes with a productivity of 72.3 metric tonnes per hectare (Anon., 2018) [3], due to its continuous vegetative growth, flowering and fruiting habits. Papaya requires high level of nutrients in a study the extent of nutrients removed by the

estimated plant at harvest have been to be 305 kg of N, 103 kg of P, 524 kg of K, 327 kg of Ca and 183 kg of Mg per hectare (Veerannah and Selvaraj, 1984) [22].

Papaya fruit is the rich source of minerals, vitamins A, B, B2 and C. It also contains calcium, iron, and phosphorus. The leaves of papaya have alkaloid called caprine. Papaya is widely used in Ayurveda. Its sap is used in the treatment of warts, caruncle, corns and calluses. Papaya sap is also used in treating psoriasis and ringworm infections. The latex extracted form fruit at 3/4th maturity which is rich in papin an active enzyme has been used as treat tendering. Adding a few pieces of papaya in curries will get meat cooked faster. Raw papaya has the ability to kill intestinal worms. Tasty jams are made from ripe papaya. Tutti- frutti used in bakery industry is made from raw papaya.

Agriculture sector is the largest consumptive user of water accounting for 71% of the freshwater use across the world. It is necessary to have effective irrigation management towards maximizing the production per unit of water consumed (Fereres and Soriano., 2007).

Studies have clearly indicated that papaya is highly sensitive to fluctuation of soil moisture as it is a shallow rooted crop. Prolonged moisture stress encourages the production of male flower leading to poor fruit set. Lower soil moisture shifts plants towards sterility with male floral characters. Contrary to this, higher moisture condition results in excessive production of undesirable carpelloid types in which the stamens fuse with developing ovary, resulting in mishappened fruits Excess water especially at early stage of growth may result in foot rot disease and as a results as whole plant may wilt at faster rate (Singh and Singh, 2010) [20] With modern greenhouse technology and production systems, the Mediterranean countries are now able to produce many tropical crops such as banana and papaya, under protected conditions Such technology has also increased the yield and improved fruit quality in comparison with open field production systems (Eckstiin and Joubfrt, 1998) [4]

Papaya *var*. Taiwan red lady 786 is one such gynodioecious variety of papaya, which is tolerant to Papaya ring spot virus, has red fleshy crispy sweet fruit having good keeping quality. Hence papaya is widely used as a table fruit. Papaya is popularly grown in India due to its suitability to tropical environmental conditions. The averaging fruit weight of 1.5 to 2.0 kg has good. Fruit setting starts at average, 70 cm above soil and mostly by nine months from the seedling stage. Fruits ship well and trees produce about 35 fruits per season. First year production is larger than second year production. Thaiwan red lady 786 variety, is less resistant to fungus than the other variety. Each gram of seed contains about 50 - 80 seeds. About 50 to 80 g seeds are required to get planting maintained sufficient to take of planting per hectare. One plant per hill average of 80 per cent seed germination.

PRSV spreads rapidly in the field and it is readily transmitted mechanically through sap. It is also stylet borne and transmitted by many species of aphid vectors in a non-persistent manner. It is not transmitted through seeds. The major symptoms on leaves are vein clearing, vein banding, mottling, distortion and yellow spots, puckering, blistering and shoe strings in severe cases appear after two to three weeks of infection. Water soaked or oily streaks on petioles, dark green concentric ring spots on fruits and even on leaves can be observed. As the disease progresses it makes the plants to stunt by appearing bushy, back headed, tapering and finally death of plants can also be noticed. Infected plants produce flowers meagerly and drastically reduces the size of fruits leading to production of malformed fruits with less sugar content, results in reduced shelf life and market value.

The incidence of Papaya Ring Spot Virus (PRSV) is higher under open field conditions whereas, cultivation of papaya under playhouse structures is expected to be protected from insect transmission of virus to a greater extent. Only few studies, either in open field or poly house or both the conditions with a recommended dose of fertilizer and irrigation along with micronutrient spray have been carried out. An elaborate study with regards to different levels of irrigations and fertilizers, along with other recommended packages including micronutrients spray based on soil test results of the proposed experimental area is needed. Hence a study with varied water and nutrient levels both under polyhouse and open field condition for comparison is envisaged. The main objectives of the proposed studies are as follows.

Material and Methods

The present investigation on the "Studies on standardization of Irrigation and Fertilizer levels on Growth, Yield and Quality of Papaya (*Cv*. Red Lady) under open field conditions". This worked was carried out in the Department of Horticulture, Gandhi Krishi Vignana Kendra, University of Agricultural Sciences, Bengaluru during season of 2018-2019 and 2019-20. The experimental station is located at an altitude of 930 m above mean sea level between a latitude of 12o58l North and a longitude of 77o35l East. The experiment was laid out in a factorial RCBD design with three replications. The total number of treatments was twelve. The dimensions of open field area was 20 m length (East-West) and 20 m breadth (North-South) with a size of 400 m2.

The observations were recorded on growth parameters like height of the plant (cm), stem girth (cm), yield parameters like number of flowers per plant, number of fruits per plant, induvial fruit weight (kg), fruit yield per plant (kg) and fruit yield per hector (t/ha) during the crop growth at 90, 180, 270, 360, 450 and 540 DAT under open field condition.

Results and Discussion

Influence of different irrigation and fertilizer levels on plant height (cm) under open field conditions

The plant height varied significantly, the increased plant height recorded at 90, 180, 270, 360, 450 and 540 days after transplanting under irrigation level of I4 i.e 60%, 90% and 120% Epan mm/day was the highest (90.67 cm, 132.08 cm, 172.33 cm, 209.63 cm, 237.15 cm, and 246.59 cm). This was followed by the irrigation level of I3 (40%, 60% and 80% Epan mm/day) with a plant height (87.50 cm, 127.58 cm, 165.62 cm, 194.73 cm, 216.43 cm, 225.13 cm). Irrigation level I1 (30%, 50% and 60% Epan mm/day) registered the lowest plant height (71.00 cm, 108.11 cm, 140.18 cm, 164.18 cm, 179.09 cm, 185.82 cm).

The results noticed with respect to fertilizer levels showed that the plant height was significantly highest (86.31 cm, 126.13 cm, 163.55 cm, 194.15 cm, 216.77 cm, 225.27 cm) in plant receiving fertilizer level of F3 @125% RDF. It was followed by the plants supplied with a fertilizer level of F2 @ 100 per cent RDF (83.19 cm, 122.67 cm, 158.96 cm, 188.48 cm,
209.39 cm, 217.64 cm). It was lowest plant height (79.44 cm, 118.48 cm, 153.82 cm, 181.76 cm, 200.53 cm, 208.33 cm) was recorded in the treatments are F1 75% RDF at 90, 180, 270, 360, 450 and 540 days after transplanting respectively.

The interaction effect of irrigation and fertilizer levels (I4F3) at 90, 180, 270, 360, 450 and 540 days after transplanting. The plants supplied with (T12 - I4F3 irrigation @ 60%, 90% and 120% Epan mm/day + fertilizer level of 125%) registered significantly the highest plant height (92.00 cm, 134.17 cm, 175.00 cm, 214.40 cm, 245.82 cm, 255.62 cm). This was followed by the treatment I4F2 60%,90% and 120% E pan(mm/day) + 100% RDF (91.25 cm, 132.83 cm,173.00 cm,211.08 cm, 239.24 cm, 248.64 cm). The other treatments were all on far with each other with respect to plant height. However, the lowest (62.00 cm, 98.83 cm,
129.76 cm, 152.76 cm, 165.96 cm and 171.96 cm) plant height was observed in the plants receiving the treatment I1F1 i.e. 30%, 50% and 60% E pan(mm/day) +75% RDF.

Although statically interpretation was not done with regards to incremental growth in plant height was apparently variation in growth between to observation i.e 3 months. There was a highest growth in terms plant height (42.17 cm) between 90-180 days after transplanting higher compared to 180-270, 270-360, 360-450 and 450-540 days after transplanting. Lesser plant height difference was seen in the 450-540 DAT (9.80), which might be due to influence of seasonal condition being cool weather October to December. Plant height rapidly increased up to six months after transplanting under open field condition which may be due to early juvenile phase.

However, irrigation level at I4F2 at 60%,90% and 120% E pan(mm/day) + 125% RDF appeared to be optimum as per as the plant height was consider as this always on far with highest irrigation and fertilizer level constant any significant difference in the plant height.

The papaya plant height under open field condition significantly differed due to varies treatments throughout its vegetative phase. Application of optimum irrigation 60%,90% and 120% E pan(mm/day) along with macronutrients 125% RDF significantly enhanced the plant growth with a height (255.62 cm) applied and the least plant height was noticed (171.96 cm) was noticed with irrigation 30%, 50% and 60% E pan(mm/day) +75% RDF. Results were so obvious that at increase level of irrigation and fertigation, plant height also increase this is due to effective utilization of fertilizers with controlled irrigation levels at a optimum rate. Soluble form at the active root zone area resulting in vigorous growth has been observed in papaya by Reddy *et al*. 1989 [17] and Kumar 1995 [12]. The results are in conformity with those found by Jeyakumar *et al*. 2002 [8], Jeyakumar *et al*. 2010 [9] and Sadarunnisa *et al*. 2010 [18].

There was continue enhance growth at the highest level of irrigation supplemented with the highest level of fertilizer levels in the present experiment were papaya was grown under open field conditions. There seemed to little variation in the incremental growth between the different period of observation recorded. This was appeared that papaya being perineal fruit crop, seasonal variation in the condition influenced decreased or increased vegetative growth. This would be more when incremental growth between the different periods of observations are presented

Influence of different irrigation and fertilizer levels on stem girth (cm) under open field conditions

The plant height at 90, 180, 270, 360, 450 and 540 days after transplanting respectively as presented in table 2 reveals the stem girth was observed to varying due to the effect of different irrigation levels. The expanded stem girth (5.67 cm, 14.48 cm, 27.04 cm,
33.46 cm, 37.82 cm, 38.93 cm) were noticed which received irrigation I4 @ level 60%, 90% and 120% Epan mm/day. It was followed by I3 @ 50%, 80% and 100% Epan mm/day (8.46 cm, 21.29 cm, 35.62 cm 43.02 cm, 48.11 cm, 50.55 cm). The lowest stem girth (9.86 cm, 23.64 cm, 38.70 cm, 46.55 cm, 52.18 cm, 55.40 cm) was recorded in the plants supplied with irrigation level (I1) @ 30%, 50% and 60% Epan mm/day.

The plants responded similarly, to the fertilizer levels with the highest (8.35 cm, 20.86 cm, 34.81 cm, 42.19 cm, 47.34 cm, 49.79 cm) being in the plants provided with F3 level @ 125 RDF followed by F2 level of fertilizers @ 100% RDF (7.65 cm, 19.66 cm, 33.58 cm, 40.71 cm, 45.65 cm, 47.81 cm) and the least stem girth (7.27 cm, 18.18 cm, 31.56 cm, 38.57 cm, 43.40 cm, 45.34 cm) was noticed being in the plants with F1 75% RDF level of fertilizer.

Proper application of irrigation water along with fertilizer here I4F3 @ 60%, 90% and 120% E pan(mm/day) + 125% (10.81 cm, 25.02 cm, 40.65 cm, 48.69 cm, 54.67 cm, 58.47
cm) found to be highly significant difference than the other treatments than followed by I4F2 (9.54 cm, 23.48 cm, 38.37 cm, 46.21 cm, 51.70 cm, 54.80 cm) at 50%, 80% and 100% E pan
mm/day than among twelve treatments I1F1 @ 30%,50% and 60% E pan(mm/day) and 75% was achieved least value of stem girth (4.96 cm, 13.23 cm, 25.47 cm, 31.67 cm, 35.87 cm 36.77 cm) was observed in this experiment under open field condition at 90, 180, 270, 360, 450 and 540 days after transplanting respectively.

The favorable effect of nitrogen in promoting the growth of the plant could be due to the fact that nitrogen application improves the movement of metabolites from source to sink (Marschner, 1983) [15]. The increase in growth parameters like stem girth under higher level of fertigation treatments during the present study might be due to the availability of major as well as minor nutrients at optimum level in the soil and assimilation of food material within the plants.

The increase in stem girth might be due to the higher uptake and accumulation of nutrients in leaf tissues which in turn ensure photosynthetic efficiency causing greater synthesis, translocation and accumulation of carbohydrates (Ghanta *et al.*, 1995) [5]. Similar findings were reported by Srinivas (2000) [21].

Influence of different levels of irrigation and fertilizer on yield and yield attributes under open field and protected conditions.

The data pertaining to the reproductive parameters such as number of flowers per plant, number of fruits per plant, individual fruit weight (kg), fruit yield per plant (kg) and fruit yield per hector (t/ha) recorded during the crop growth period under open field condition are presented in Table 3.

Number of flowers per plant

The highest number of flowers (63.19) was produced by the plants irrigated by drip at 60%, 90% and 120% E pan(mm/day). This was followed by I3 @ 50%, 80% and 100% E pan(mm/day). (60.45). Lowest number of flowers (56.12) was noticed in I1 (30%, 50% and 60% E pan(mm/day). Significantly higher number of flowers (60.41) was seen in F3 @ 125% RDF precede by F2 @ 100% RDF 59.70 and lesser number of flowers (58.84) was observed under fertilizer level F1 @ 75% RDF.

When data were subjected to statistical analysis test, it was observed that significantly the more number of flowers

(64.09) was noticed in the papaya plants due to interaction effect of I4 and F3 i.e. supply of water @ 60%, 90% and 120% E pan(mm/day) and @ 125% RDF respectively. This was followed by I4F2 level of irrigation and fertilizer levels i.e (63.19) 60%, 90% and 120% E pan(mm/day) + 100 per cent RDF. Lesser number of flower (55.02) was noticed in plants due to combined the effect of irrigation and fertilizer levels at the lowest levels in the experiment @ 30%,50% and 60% E pan(mm/day) +75% RDF respectively.

Number of fruits per plant

Significant differences was observed in data related to number of fruits per plant it is due to different levels of irrigation (table 3). The plants receiving irrigation level at I4 at 60%,90% and 120% E pan(mm/day) resulted in significantly the highest number of fruit (36.07). It was followed by 50%,80% and 100% E pan(mm/day) 34.82. Lesser number of fruit (32.40) was noticed in plant receiving 30%,50% and 60% E pan(mm/day). With respect to fertilizer level plant receiving highest fertilizer dose @ 125% RDF resulted in significantly the higher number of fruit (34.62). This was followed by @ 100% RDF 34.31 and lesser number of fruit (33.95) was recorded in at 75% RDF.

The effect of interactions was found significant for highest number of fruits was observed under different irrigation and fertilizer levels here I4F3 @ 60%,90% and 120% E pan mm/day and 125% RDF shows higher number of fruit (36.23). This was followed by I4F2 @ 60%, 90% and 120% E pan mm/day and 100% RDF (35.36 kg) and lesser number of fruit (31.93) was noticed in I1F1 at 30%, 50% and 80% E pan mm/day and 75% RDF.

Individual fruit weight (kg)

Significant differences was observed in data related to fruit weight of papaya due to different levels of irrigation. The plants receiving irrigation level at I4 at 60%, 90% and 120% E pan(mm/day) resulted in significantly the highest average fruit weight (1.11 kg) and followed by 50%, 80% and 100% E pan(mm/day) 1.01 kg. Lowest average fruit weight (0.85 kg) was noticed in plant receiving 30%, 50% and 60% E pan(mm/day). Plant receiving highest fertilizer dose @ 125% RDF resulted in significantly the higher average fruit weight (1.01 kg). This was followed by at 100% RDF 0.97 kg and lower average fruit weight (0.95 kg) was observed in fertilizer dose @ 75% RDF.

The effect of interactions was found significant for average fruit weight of under different irrigation and fertilizer levels here I4F3 @ 60%, 90% and 120% E pan mm/day and 125% RDF shows higher average fruit weight (1.15 kg). This was followed by I4F2 @ 50%,80% and 100% E pan mm/day and 100% RDF (1.11 kg). Lowest average fruit weight (0.83 kg) was noticed in I1F1 at 30%, 50% and 80% E pan mm/day and 125% RDF.

Fruit yield per plant (kg)

It is obvious from the data that effect of various levels of irrigation had proved significant in terms of papaya fruit yield per plant (table 3). The plants of papaya cv. Red lady irrigated with treatment involving (I4) at 60%, 90% and 120% E pan(mm/day) was registered significantly the highest fruit yield (40.16 kg) and followed by (I3) 50%,80% and 100% E pan(mm/day) 35.06 kg. Lowest fruit yield per plant (27.55 kg) was observed in I1 at 30%, 50% and 60% E pan(mm/day). The plants of papaya fertilized at level F3 at 125% RDF produced higher fruit yield per plant (34.93 kg) and followed by F2 at 100% RDF 33.49 kg. Lower fruit yield per plant (32.30 kg) was noticed plant supplied at 75% RDF.

The least fruit yield per plant (26.50 kg) was observed in the plants irrigated and fertigated at I1 & F1 at 60%, 90% and 120% E pan(mm/day) and 125% RDF. It was followed by I4F2 at 60%, 90% and 120% E pan(mm/day) + 100% RDF 40.07 kg and highest fruit yield per plant (41.66 kg) was observed in (I1F1) at 30%,50% and 80% E pan(mm/day) and 75% RDF.

Yield per hector (t/ha)

The plants of papaya receiving irrigation level I4 at 60%, 90% and 120% E pan(mm/day) was observed significantly the highest yield per hector (128.62 t/ha) it was followed by plant receiving irrigation level I3 at 50%, 80% and 100% E pan(mm/day) 123.70 t/ha and lower level of irrigation gave I1 at 30%, 50% and 60% E pan(mm/day was noticed lesser yield (85.05 t/ha) as compared to higher level of irrigation. The plants under the treatment of fertilizer level F3 at 125% RDF recorded higher fruit yield per hector (107.82 t/ha). This was followed by F2 at 100% RDF (103.40 t/ha) and lower yield per hector (99.71 t/ha) was noticed in F1 @ 75% RDF.

The effect of interactions on different irrigation and fertilizer levels here I4F3 at 60%, 90% and 120% E pan(mm/day) and 125% RDF was found to be significant for higher fruit yield per hectare (128.62 t/ha) it was followed by I4F2 at 50%,80% and 100% E pan(mm/day) with application of 100% RDF (123.70 t/ha). Lesser yield per hector (81.81 t/ha) was achieved in I1F1 at 30%, 50% and 60% E pan(mm/day) along with 75% RDF.

The positive influence of higher levels irrigation and fertigation (T12) I4F3 at 60%, 90% and 120% E pan(mm/day) and 125% RDF on yield attributes characteristics ultimately reflected in higher, number of flowers per plant, number of fruits per plant, average fruit weight, yield per plant and yield per hector of papaya in these particular treatments in present study. This might be due to the increase in yield traits which helped to increase the synthesis of carbohydrates which utilized for the development of fruits.

It is might be due to constant and continuous supply of water and nutrients in soluble form to the wetted area of the root zone ensuring better availability of nutrients (Mahalakshmi *et al.,* 2001 b and Kavino *et al.,* 2004). Regular supply of nitrogen to the plants increased yield and yield attributing characters because it is directly related to the synthesis of protein through amino acids (Hussain, 1970). Apart from this, drip irrigation restricts the fluctuations in soil water potential within a narrow range and maintained favorable water regime leading to higher yield.

Influence of different levels of irrigation and fertilizer on cost economics of papaya cv. Red lady under open field conditions.

Influence of different levels of irrigation and fertilizer on cost economics of growing papaya cv. Red lady is presented in Table 4 under open field condition.

The highest yield (126.80 tonnes), gross returns (Rs 19,29,300/-) and net returns (Rs. 23,76,900/-), with a cost benefit ratio of (1:2.11) was achieved in papaya crop grown under open field with the treatment T12 (I4F3 - 60%,90% and 120% E pan(mm/day) + 125% RDF). The cost economics have indicated that its required higher quantity of water application at a given fertilizer combination was found to be optimum and beneficial for papaya grown under open field condition.

Among the all the treatment T12 (I4F3 - 60%, 90% and 120% E pan(mm/day) + 125% RDF) showed higher B:C ratio under open field condition (1:2.11) and lower B:C ratio was observed in I1F1 at 30%, 50% and 60% E pan(mm/day) along with 75% RDF (1:3.6). Higher B/C ratio in T12 (I4F3 - 60%, 90% and 120% E pan(mm/day) + 125% RDF) was due to high yield influenced by higher moisture content in the soil and timely application of macronutrients, which favoured to produce higher number of marketable fruits with good shape, size, quality and also lesser per cent of infection with delayed PRSV incidence.

Table 1: Effect of different levels of irrigation and fertilizer on plant height (cm) of Papaya (*cv*. Red Lady) under open field condition

Treatments	90 DAT	180 DAT	270 DAT	360 DAT	450 DAT	540 DAT
Irrigation levels						
I1	71.00	108.11	140.18	164.18	179.09	185.82
I2	82.75	121.92	156.98	183.98	202.91	210.78
I3	87.50	127.58	165.62	194.73	216.43	225.13
I4	90.67	132.08	172.33	209.63	237.15	246.59
S.E m+	0.29	0.34	0.45	1.03	0.78	0.81
CD at 5%	0.85	1.00	1.32	3.01	2.27	2.38
Fertilizer level						
F1	79.44	118.48	153.82	181.76	200.53	208.33
F2	83.19	122.67	158.96	188.48	209.39	217.64
F3	86.31	126.13	163.55	194.15	216.77	225.27
S.Em +	0.25	0.30	0.39	0.89	0.67	0.70
CD at 5%	0.74	0.87	1.14	2.60	1.97	2.06
Irrigation X Fertilizer level						
I1F1	62.00	98.83	129.76	152.76	165.96	171.96
I1F2	72.50	109.75	141.73	165.73	180.85	187.85
I1F3	78.50	115.75	149.06	174.06	190.46	197.66
I2F1	80.25	119.17	153.47	179.47	197.36	204.96
I2F2	81.75	120.75	155.90	182.90	201.82	209.72
I2F3	86.25	125.83	161.56	189.56	209.56	217.66
I3F1	86.75	126.67	163.06	191.39	212.39	220.89
I3F2	87.25	127.33	165.22	194.22	215.64	224.34
I3F3	88.50	128.75	168.58	198.58	221.25	230.15
I4F1	88.75	129.25	169.00	203.40	226.40	235.50
I4F2	91.25	132.83	173.00	211.08	239.24	248.64
I4F3	92.00	134.17	175.00	214.40	245.82	255.62
S.Em+	0.50	0.59	0.78	1.78	1.34	1.41
CD at 5%	1.48	1.74	2.28	5.21	3.94	4.12
CV (%)	13.16	11.64	11.70	12.64	13.65	13.71

Irrigation levels	1-4 Months	5-9 Months	10-14 Months
I1	30%	50%	60%
I2	40%	60%	80%
I3	50%	80%	100%
I4	60%	90%	120%

Fertilizer levels	RDF
F1	75% RDF
F2	100% RDF
F3	125% RDF

Table 2: Effect of different levels of irrigation and fertilizer on stem girth (cm) of Papaya (*Cv*. Red Lady) under open field condition

Treatments	90 DAT	180 DAT	270 DAT	360 DAT	450 DAT	540 DAT
Irrigation levels						
I1	5.67	14.48	27.04	33.46	37.82	38.93
I2	7.03	18.85	31.90	38.92	43.75	45.73
I3	8.46	21.29	35.62	43.02	48.11	50.55
I4	9.86	23.64	38.70	46.55	52.18	55.40
S.Em+	0.10	0.25	0.16	0.18	0.19	0.29
CD at 5%	0.28	0.74	0.47	0.53	0.57	0.84
Fertilizer levels						
F1	7.27	18.18	31.56	38.57	43.40	45.34
F2	7.65	19.66	33.58	40.71	45.65	47.81
F3	8.35	20.86	34.81	42.19	47.34	49.79
S.Em +	0.08	0.22	0.14	0.16	0.17	0.25
CD at 5%	0.24	0.64	0.41	0.46	0.49	0.72

Irrigation X Fertilizer levels						
I1F1	4.96	13.23	25.47	31.67	35.87	36.77
I1F2	5.78	14.75	27.40	33.67	38.01	39.19
I1F3	6.28	15.46	28.24	35.05	39.57	40.83
I2F1	6.70	16.04	28.98	35.92	40.69	42.51
I2F2	6.95	19.78	32.82	39.83	44.65	46.63
I2F3	7.45	20.74	33.91	41.02	45.90	48.04
I3F1	8.18	21.04	34.71	41.91	46.87	49.17
I3F2	8.33	21.73	35.73	43.14	48.23	50.64
I3F3	8.85	22.22	36.43	44.00	49.23	51.83
I4F1	9.24	22.43	37.08	44.76	50.18	52.92
I4F2	9.54	23.48	38.37	46.21	51.70	54.80
I4F3	10.81	25.02	40.65	48.69	54.67	58.47
S.Em ±	0.17	0.43	0.28	0.31	0.34	0.49
CD at 5%	0.48	1.28	0.81	0.92	0.99	1.45
CV (%)	22.10	19.32	16.27	15.01	15.88	15.01

Irrigation levels	1-4 Months	5-9 Months	10-14 Months
I1	30%	50%	60%
I2	40%	60%	80%
I3	50%	80%	100%
I4	60%	90%	120%

Fertilizer levels	RDF
F1	75% RDF
F2	100% RDF
F3	125% RDF

Table 3: Effect of different levels of irrigation and fertilizer on yield parameter of Papaya (*Cv.* Red Lady) under open field conditions

Treatments	Number of flower plant	Number of fruits per plant	Fruit wight (kg)	Yield / plant (kg)	(Yield t/ha)
Irrigation levels					
I1	70.00	34.94	0.86	32.60	100.59
I2	78.00	38.93	0.95	41.12	126.91
I3	87.67	43.76	1.10	46.08	142.20
I4	99.33	49.58	1.40	51.36	158.51
S.Em±	0.40	0.10	0.01	0.33	1.02
CD at 5%	1.17	0.29	0.02	0.96	2.98
Fertilizer levels					
F1	80.25	40.06	1.01	40.28	124.30
F2	83.25	41.56	1.08	42.60	131.48
F3	87.75	43.80	1.15	45.49	140.37
S.Em ±	0.34	0.09	0.01	0.28	0.88
CD at 5%	1.01	0.25	0.02	0.84	2.58
Irrigation levels X Fertilizer levels					
I1F1	68.00	33.94	0.80	29.95	92.43
I1F2	70.00	34.94	0.85	30.55	94.27
I1F3	72.00	35.94	0.92	37.29	115.07
I2F1	75.00	37.44	0.93	37.94	117.07
I2F2	78.00	38.93	0.95	42.45	131.01
I2F3	81.00	40.43	0.97	42.98	132.63
I3F1	83.00	41.43	0.99	43.61	134.57
I3F2	87.00	43.43	1.10	46.27	142.80
I3F3	93.00	46.42	1.20	48.35	149.22
I4F1	95.00	47.42	1.30	49.62	153.14
I4F2	98.00	48.92	1.40	51.14	157.82
I4F3	105.00	52.41	1.50	53.33	164.57
S.Em ±	0.69	0.17	0.01	0.57	1.76
CD at 5%	2.02	0.51	0.04	1.67	5.16
CV (%)	8.18	7.47	6.02	7.64	8.24

Irrigation levels	1-4 Months	5-9 Months	10-14 Months
I1	30%	50%	60%
I2	40%	60%	80%
I3	50%	80%	100%
I4	60%	90%	120%

Fertilizer levels	RDF	RDF
F1	75% RDF	100% RDF
F2	100% RDF	125% RDF
F3	125% RDF	150% RDF

Table 4: Economics of cultivation of Papaya cv. Red Lady under open field condition for eighteen months on an area of 1hectare.

Treatment combinations	Total yield per ha (tons)	Total cost of cultivation (Rs.)	Gross return (Rs.)	Net return (Rs.)	B/C ratio
I1F1	81810	899802	1227150	327348	1.36
I1F2	85120	908801	1276800	367999	1.40
I1F3	88210	914422	1323150	408728	1.45
I2F1	93440	899802	1401600	501798	1.56
I2F2	97570	908801	1463550	554749	1.61
I2F3	100920	914422	1513800	599378	1.66
I3F1	103980	899802	1559700	659898	1.73
I3F2	107200	908801	1608000	699199	1.77
I3F3	113520	914422	1702800	788378	1.86
I4F1	119620	899802	1794300	894498	1.99
I4F2	123700	908801	1855500	946699	2.04
I4F3	128620	914422	1929300	1014878	2.11

$$\text{Benefit / Cost ratio} = \frac{\text{Gross returns (Rs. ha-1)}}{\text{Cost of cultivation (Rs. ha-1)}}$$

Note: Papaya fruits were sold at Rs.15 per Kg

Irrigation levels	1-4 Months	5-9 Months	10-14 Months
I1	30%	50%	60%
I2	40%	60%	80%
I3	50%	80%	100%
I4	60%	90%	120%

Fertilizer levels	RDF
F1	75% RDF
F2	100% RDF
F3	125% RDF

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