LR-4691
[1-6]

RESEARCH ARTICLE

Legume Research- An International Journal, Volume Issue : ()

Influence of Different Levels of Drip Fertigation and Mulching on Growth, Yield, Water Productivity and Nutrient Uptake of Pigeonpea (*Cajanus cajan* L.)

Sunil Kumar, C. Seenappa, Vikramarjun Madam, M.R. Anand

10.18805/LR-4691

ABSTRACT

Background: Pigeonpea is second most important pulse crop grown after chickpea in India. Pigeonpea is versatile crop can be grown in vast agro climatic condition with low inputs. However, the yield is very low as compared to the potential yield as grown in rainfed condition, the drip fertigation and mulching can increase resource use efficiency. Both these techniques are resource saving and realized maximum yield by reducing the nutrient and water losses as compared to conventional practices.

Methods: The experiment was laid out in factorial complete randomized block design and replicated thrice. The experiment consisted of two levels of irrigation (0.50 CPE and 0.75 CPE) as one factor and three fertility levels (100% RDF, 75% RDF and 50% RDF) as second factor and two levels of mulching (without mulching and with plastic mulching 25 micron) as third factor.

Result: The results revealed that higher level of irrigation (0.75 CPE) with 100 per cent RDF and with plastic mulching recorded significantly higher growth rate, seed yield and uptake of nutrients by the pigeonpea crop.

Key words: Drip irrigation, Fertigation, Mulching, Pigeonpea, Water productivity.

INTRODUCTION

Pigeonpea [*Cajanus cajan* (L.) Millsp.] also known as red gram, Tur or *arhar* is the fifth major pulse crop grown throughout the globe and second prominent pulse crop in India after chickpea. Global pigeonpea cultivation increased at an annual rate of 1.3% from about 2.7 million hectares in 1961 to about 4.6 million hectares in 2007 and production grew at an annual rate of 2.5% from about 2.2 million tons in 1961 to about 3.4 million tons in 2007 representing an increase of about 54% (FAO, 2008). Pigeonpea remained at second position in total pulse production with 4.25 m t recorded in an area of 4.45 m ha with average productivity of 960 kg ha^{-1} (Anonymous, 2018) in the country. Pigeonpea has good yield potential but production and productivity is very low because it is cultivated as rainfed crop in marginal lands of semi-arid tropics.

Drip irrigation has significant impact on resource saving, crop yield and profitability of farm compared to other means of irrigation methods. Drip fertigation is a highly input efficient method to minimize the irrigation losses, better fertilizer application and adverse environmental impact on crop production. Both water and nutrient uptake enhanced by the plants and realized maximum dry matter production and yield through drip fertigation (Ramana Rao *et al*., 2018). The nutrient and water losses from the soil is minimized through mulching and they are utilized effectively to a greater extent. Among the production factors of crop production, irrigation and nutrient management has immense importance in profitable farming. Mulching is one of the most promising practice among different methods of moisture conservation. Mulching helps to reduce the evaporation losses from soil, preventing the soil particles from direct contact of rain drops which helps to control the soil erosion and check run-off losses. Application of mulching on soil surface helps to maintain the optimum soil temperature which favours plant growth, suppress the weed growth and prevent the nutrient losses from the soil (Kamar *et al.,* 2018). Thus to combat with the moisture stress under rainfed condition, an experiment was conducted with objectives to find out the effect of drip fertigation under different nutrient levels and mulching.

Department of Agronomy, Gandhi Krishi Vigyan Kendra, University of Agricultural Sciences, Bangalore-560 065, Karnataka, India.

Corresponding Author: Sunil Kumar, Department of Agronomy, Gandhi Krishi Vigyan Kendra, University of Agricultural Sciences, Bangalore-560 065, Karnataka, India.
Email: sunilbhardwaj8207@gmail.com

How to cite this article: Kumar, S., Seenappa, C., Madam, V. and Anand, M.R. (2021). Influence of Different Levels of Drip Fertigation and Mulching on Growth, Yield, Water Productivity and Nutrient Uptake of Pigeonpea (*Cajanus cajan* L.). Legume Research. DOI: 10.18805/LR-4691.

Submitted: 09-06-2021 **Accepted:** 30-10-2021 **Online:** 17-01-2022

MATERIALS AND METHODS

A field experiment was conducted during *Kharif* 2019 at Zonal Agricultural Research Station (ZARS), Gandhi Krishi Vigyan Kendra (GKVK), University of Agricultural Sciences (UAS), Bangalore. The center is situated in the agro-climatic zone V: Eastern Dry Zone of Karnataka at 12°58' North latitude and 77°35' East longitude with an altitude of 930 m above mean sea level, the soil of experimental site was red sandy loam. The experiment consisted of two levels of irrigation (0.50 CPE and 0.75 CPE) as one factor and three fertility levels (100% RDF, 75% RDF and 50% RDF) as second factor and two levels of mulching (without mulching and with plastic mulching 25 micron) as third factor. The soil was low in available nitrogen (262.08 kg ha^{-1}), medium in available phosphorus (20 kg ha^{-1}) and available potassium (269.7 kg ha^{-1}). The soil was acidic in nature (5.87) with electrical conductivity in the safer range. The RDF (recommended dose of fertilizer) 25:50:25 N, P_2O_5 and K_2O kg ha^{-1} was respectively, which was applied through urea DAP and MOP. Cultivar BRG-5 was sown in paired row with spacing of 180 between two paired, 60 cm within pair and 30 cm plant to plant (180/60 cm × 30 cm). Drip irrigation was schedule once in week up to flowering and then once in every three days after flowering based on CPE value.

RESULTS AND DISCUSSION

Influence of drip fertigation and mulching on growth parameters of pigeonpea

Growth parameters of pigeonpea were affected significantly due to various levels of irrigation, fertility levels and mulching were presented (Table 1 and 1.1).

Plant height

The increase in plant height up to 40 DAS is very slow because of initial slow growth rate of pigeonpea, thereafter plant height increased linearly at 80 and 120 DAS as this is the grand growth period. Thereafter, growth occurred at diminishing rate with different factors like irrigation, fertigation and mulching. The increase in plant height was due to optimum availability of moisture at 0.75 CPE in entire growth period and there was no competition from weeds because weeds were suppressed by mulching and efficient utilization of fertilizers applied through drip irrigation. The findings are similar with the findings of Mathukia *et al.* (2015) and Ramana Rao *et al.* (2018).

Leaf area (cm^2 $plant^{-1}$)

The highest leaf area $plant^{-1}$ was recorded with 0.75 CPE, 100 per cent RDF and mulching may be due to controlled environmental condition and more interception of sunlight and more photosynthesis might have increased leaf area $plant^{-1}$. This may be because of optimum moisture and nutrient availability synchronizing with supply and demand of nutrients and by conserving the more moisture and controlling the weed growth by the mulching. The interaction effects of all the factors were higher because of more availability of nutrients, moisture and uptake of nutrients was also higher. Ramana Rao *et al*. (2018), Shirgapure and Fathima (2018) and Solanki *et al.* (2019) have also recorded same trends in leaf area $plant^{-1}$.

Dry matter accumulation

The dry matter accumulation during initial crop growth period was very less because of initial slow growth and it progressively increased up to 120 DAS thereafter increase with diminishing rate up to harvest because dry matter is a function of leaf area, number of branches and more number of leaves which was maximum at 120 DAS and then decline due to leaf senescence. At harvest, higher dry weight $plant^{-1}$ was observed with irrigation at 0.75 CPE (121.8 g) while lower dry matter accumulation $plant^{-1}$ with irrigation at 0.50 CPE (111.8 g). The total dry matter accumulation $plant^{-1}$ was noticed in higher levels of fertigation *i.e.*, 100 per cent RDF (122.7 g) followed by 75 per cent RDF (114.3 g) and 50 per cent RDF (113.3 g), respectively. The dry matter $plant^{-1}$ with mulching (124.0 g) was significantly higher than without mulching (109.5 g). The increase in dry matter of pigeonpea up to harvest is due to sufficient availability of moisture and reduce the weed growth and low evaporation loss of moisture from the soil due to mulching effect. Higher fertigation levels provide more nutrients to plant which helped in vigorous growth of the plant contributed to more dry matter production. These findings were similar with Shirgapure and Fathima (2018) and Swathi *et al*. (2018).

Influence of drip fertigation and mulching on yield parameters and yield of pigeonpea

yield parameters and yield as influenced with different levels of irrigation and mulching are presented in Table 2 and 2.1.

Number of pods $plant^{-1}$

Maximum pods $plant^{-1}$ was recorded under higher levels of irrigation at 0.75 CPE (172.5) which significantly differed from irrigation at 0.50 CPE (149.8). The higher number of pods $plant^{-1}$ was noticed in 100 per cent RDF (172.6) and lower in 50 per cent RDF (148.5). Among the mulching treatments maximum number of pods $plant^{-1}$ was recorded with plastic mulching M_1 (178.4) compared to without mulching (143.9). The possible reason for higher number of pods $plant^{-1}$ due to sufficient moisture, more availability of nutrients and absorption of nutrients, luxurious vegetative growth and lower flower dropping. These results were in accordance with, Savani *et al*. (2017) and Shirgapure and Fathima (2018).

Number of seeds pod^{-1}

Number of seeds pod^{-1} were influenced significantly with irrigation, fertility and mulching levels. Irrigation with 0.75 CPE recorded significantly higher number of seeds pod^{-1} (4.5) than 0.50 CPE (4.1). The higher levels of fertilizer with 100 per cent RDF (4.6) fortified significantly higher number of seeds than rest of fertigation levels. Mulching treatment recorded higher number of seeds pod^{-1} (4.5) than no mulching (4.1). The higher number of seeds pod^{-1} were recorded with higher moisture regime and mulching. This was probably due to more vegetative growth, more flowering and efficient partition between source and sink. The similar results were also reported by Ramana Rao *et al.* (2018).

Seed yield

The crop irrigated with drip system at 0.75 CPE recorded

Table 1: Plant growth parameters of pigeonpea as influenced by drip fertigation and mulching.

Treatments	Plant height (cm)				Leaf area (cm^2 plant^{-1})				Dry matter accumulation (g plant^{-1})			
	40 DAS	80 DAS	120 DAS	At harvest	40 DAS	80 DAS	120 DAS	At harvest	40 DAS	80 DAS	120 DAS	At harvest
Irrigation levels (I)												
I_1: 0.50 CPE	23.4	105.0	161.3	169.0	65	4203	6205	4403	1.9	67.8	100.1	111.8
I_2: 0.75 CPE	28.3	121.8	178.8	185.6	105	4554	7514	4778	2.3	72.6	106.2	121.8
SEm (.±)	0.6	2.1	3.4	3.4	4.1	115.9	252.9	127.4	0.1	1.5	2.0	2.2
C.D (5%)	1.7	6.3	10.1	10.0	12.1	340.0	741.9	373.7	0.3	4.4	6.0	6.6
Fertilizer levels (F)												
F_1 :100% RDF	29.5	118.7	181.4	186.1	108	4901	7431	5111	2.8	75.6	110.5	122.7
F_2 : 75% RDF	25.4	112.5	168.1	170.6	85	4239	6934	4414	2.0	71.9	100.8	114.3
F_3 : 50% RDF	22.6	109.0	160.6	165.3	62	3994	6213	4247	1.7	63.1	98.0	113.3
SEm (.±)	0.7	2.6	4.3	4.2	5.0	142.0	309.8	156.0	0.1	1.8	2.5	2.7
C.D (5%)	2.1	7.7	12.5	12.3	14.8	416.5	908.6	457.7	0.3	5.4	7.3	8.1
Mulching levels (M)												
M_0 : Without mulching	22.8	102.5	157.0	163.5	59	3785	6274	3943	1.9	65.2	96.0	109.5
M_1 : With Mulching	28.9	124.3	183.0	191.2	111	4971	7446	5238	2.3	75.1	110.2	124.0
SEm (.±)	0.6	2.1	3.4	3.4	4.1	115.9	252.9	127.4	0.1	1.5	2.0	2.2
C.D (5%)	1.7	6.3	10.1	10.0	12.1	340.0	741.9	373.7	0.3	4.4	6.0	6.6

Table 1.1: Plant growth parameters of pigeonpea as influenced by interaction of drip fertigation and mulching.

Treatment combinations	Interaction effect of (IxFxM) on Plant height (cm)				Interaction effect of (IxFxM) on leaf area (cm^2 plant^{-1})				Interaction effect of (IxFxM) on Dry matter accumulation (g plant^{-1})			
	40 DAS	80 DAS	120 DAS	At harvest	40 DAS	80 DAS	120 DAS	At harvest	40 DAS	80 DAS	120 DAS	At harvest
$I_1 F_1 M_0$	20.8	91.5	152.1	157.1	68.	4199	5360	4265	20.8	91.5	152.1	157.1
$I_1 F_1 M_1$	27.7	125.5	188.9	190.1	108	5081	8456	5343	27.7	125.5	188.9	190.1
$I_1 F_2 M_0$	20.9	99.5	155.8	156.3	40	4219	6225	4272	20.9	99.5	155.8	156.3
$I_1 F_2 M_1$	25.5	101.0	156.6	164.1	56	3897	6174	4186	25.5	101.0	156.6	164.1
$I_1 F_3 M_0$	21.7	100.7	147.9	161.0	51	3363	4770	3570	21.7	100.7	147.9	161.0
$I_1 F_3 M_1$	24.3	112.3	166.5	185.8	68	4456	6247	4785	24.3	112.3	166.5	185.8
$I_2 F_1 M_0$	32.4	120.2	181.3	187.6	86	4336	6492	4749	32.4	120.2	181.3	187.6
$I_2 F_1 M_1$	37.3	137.9	203.7	209.7	169	5989	9418	6087	37.3	137.9	203.7	209.7
$I_2 F_2 M_0$	21.7	104.3	155.9	158.9	59	3495	7745	3545	21.7	104.3	155.9	158.9
$I_2 F_2 M_1$	33.7	125.3	201.5	206.2	185	5346	7592	5652	33.7	125.3	201.5	206.2
$I_2 F_3 M_0$	19.5	99.0	146.7	163.1	50	3099	7050	3258	19.5	99.0	146.7	163.1
$I_2 F_3 M_1$	25.2	124.3	181.4	191.6	80	5058	6787	5374	25.2	124.3	181.4	191.6
SEm(.±)	1.4	5.2	8.5	8.3	10.1	284.0	619.5	312.1	1.4	5.2	8.5	8.3
C.D (5%)	NS	15.5	NS	NS	29.75	NS	NS	NS	NS	15.5	NS	NS

higher seed yield (1364 kg ha^{-1}) compared to lower irrigation at 0.50 CPE (1166 kg ha^{-1}). The highest seed yield was obtained with higher levels of fertigation with 100 per cent RDF (1509 kg ha^{-1}) followed by 75 and 50 per cent RDF (1197 and 1089 kg ha^{-1}, respectively). Significantly higher seed yield was recorded with plastic mulching (1423 kg ha^{-1}) as compared to without mulching (1107 kg ha^{-1}). Seed yield of pigeonpea was significantly higher due to individual factors and their interaction effects. This was because of higher levels of irrigation provide optimum moisture to plant and higher fertility levels provides more nutrients to plant in available form and reduce the losses of nutrients because they were supplied through drip irrigation which helps to match the supply and demand of crops. Mulching reduces the evaporation losses of moisture from the soil and maintains optimum temperature and also reduces the weeds which helps to provide weed free condition as such the crop growth was good and contributes higher seed yield. Similar findings were reported by Savani *et al*. (2017) and Kamar *et al.* (2018).

The interaction effect of drip fertigation and mulching on yield and water productivity of pigeonpea (Table 2). Revealed that treatment combination $I_2F_1M_1$ (0.75 CPE, 100% RDF and with plastic mulching) recorded significantly higher yield (2091 kg ha^{-1}) compared to rest of treatment combinations.

Stalk yield

The stalk yield of pigeonpea was influenced significantly due to different levels of irrigation, fertigation and mulching. The crop irrigated with drip at 0.75 CPE recorded higher stalk yield (3777 kg ha^{-1}) compared to the lower level of irrigation with 0.50 CPE (3464 kg ha^{-1}). The highest stalk yield ha^{-1} was obtained with 100 per cent RDF (3815 kg ha^{-1}) followed by 75 per cent and 50 per cent RDF (3620 and 3426 kg ha^{-1}, respectively). Higher stalk yield ha^{-1} was recorded with mulching (3923 kg ha^{-1}) as compared to without mulching (3318 kg ha^{-1}). Similar results have been found by Patel *et al*. (2015) and Mathukia *et al*. (2015). This might be due to optimum moisture available during entire crop growth period and fertilizers were applied through drip which reduce losses and efficiently uptake of nutrients led to taller plant, maximum number of branches and more leaf area $plant^{-1}$ and finally more dry matter or stalk yield. Further mulching reduces the competition for nutrients and space by suppressing the weeds which helps to increase plant canopy vigorously and produce more stalk yield.

Effect of drip fertigation and mulching on water productivity of pigeonpea

The water productivity of different irrigation levels (0.50 CPE) and (0.75 CPE) was obtained 67.3 and 59.4 kg ha-cm^{-1}, respectively which indicates that water productivity at 0.50 CPE was significantly higher than 0.75 CPE (Table 2 and 2.1). Higher water productivity was recorded in higher fertigation level of 100 per cent RDF (75.3 kg ha-cm^{-1}) followed by 75 per cent RDF and 50 per cent RDF (59.8 and 55.0 kg ha-cm^{-1} respectively). The mulching recorded higher water productivity (71.1 kg ha-cm^{-1}) than without mulching (55.7 kg ha-cm^{-1}). The similar findings were reported by Kumar *et al*. (2016) and Savani *et al*. (2017).

The interaction effect of irrigation, fertigation and mulching on water productivity was found to be significant. Highest water productivity 91.2 kg ha-cm^{-1} was recorded with $I_2F_1M_1$ (0.75 CPE, 100 % RDF and with mulching) than rest of the treatment combinations, but on par with $I_1F_1M_1$ *i.e.* (0.50 CPE, 100 % RDF and with mulching) 84.1 kg ha-cm^{-1}. Similar finding was reported by Solanki *et al.* (2019).

These results indicated that lower levels of irrigation recorded higher water productivity because of more yield was produced with less amount of water. Higher water productivity was observed with interaction effect because

Table 2: yield attributes, yield and water productivity of pigeonpea as influenced by drip fertigation and mulching.

Treatments	Pods per plant	Number of seeds per pods	Seed yield (kg ha^{-1})	Stalk yield (kg ha^{-1})	Water productivity (kg ha-cm^{-1})
Irrigation levels (I)					
I_1: 0.50 CPE	149.8	4.1	1166	3464	67.3
I_2: 0.75 CPE	172.5	4.5	1364	3777	59.4
SEm (.±)	4.5	0.1	29.5	75.8	1.5
C.D (5%)	13.4	0.3	86.5	222.3	4.4
Fertilizer levels (F)					
F_1: 100 % RDF	172.6	4.6	1509	3815	75.3
F_2: 75% RDF	162.4	4.3	1197	3620	59.8
F_3: 50% RDF	148.5	4.0	1089	3426	55.0
SEm (.±)	5.6	0.1	36.1	92.8	1.8
C.D (5%)	16.5	0.4	106.0	272.3	5.45
Mulching levels (M)					
M_0: Without mulching	143.9	4.1	1107	3318	55.7
M_1: With Mulching	178.4	4.5	1423	3923	71.1
SEm (.±)	4.5	0.1	29.5	75.8	1.5
C.D (5%)	13.4	0.3	86.5	222.3	4.4

Table 2.1: Yeld attributes, yield and water productivity of pigeonpea as influenced by interaction of drip fertigation and mulching.

Treatment combinations	Pods per plant	Number of seeds per plant	Seed yield (kg ha^{-1})	Stalk yield (kg ha^{-1})	Water productivity (kg ha-cm^{-1})
$I_1 F_1 M_0$	139.5	4.3	1238	3204	71.5
$I_1 F_1 M_1$	178.5	4.6	1457	4133	84.1
$I_1 F_2 M_0$	138.3	4.1	936	3129	54.1
$I_1 F_2 M_1$	168.8	4.2	1227	3726	70.9
$I_1 F_3 M_0$	128.9	3.6	985	3116	56.9
$I_1 F_3 M_1$	145.4	4.1	1152	3476	66.5
$I_2 F_1 M_0$	151.4	4.6	1249	3602	54.5
$I_2 F_1 M_1$	221.3	5.1	2091	4323	91.2
$I_2 F_2 M_0$	153.5	4.4	1219	3526	53.1
$I_2 F_2 M_1$	189.4	4.7	1407	4098	61.4
$I_2 F_3 M_0$	152.4	4.0	1013	3332	44.2
$I_2 F_3 M_1$	167.4	4.3	1206	3781	52.6
SEm(.±)	11.2	0.2	72.2	185.7	3.7
C.D (5%)	NS	NS	212.0	NS	10.9

Table 3: Nutrient uptake by pigeonpea as influenced by drip fertigation and mulching.

Treatments	N (kg ha^{-1})	P_2O_5 (kg ha^{-1})	K_2O (kg ha^{-1})
Irrigation levels (I)			
I_1: 0.50 CPE	60.4	8.9	86.8
I_2: 0.75 CPE	64.6	9.5	92.5
SEm (.±)	1.2	0.1	1.7
C.D (5%)	3.7	0.5	5.1
Fertilizer levels (F)			
F_1: 100% RDF	67.7	10.2	96.5
F_2: 75% RDF	62.7	9.1	89.9
F_3: 50% RDF	57.1	8.3	82.5
SEm (.±)	1.5	0.2	2.1
C.D (5%)	4.6	0.6	6.2
Mulching levels (M)			
M_0: Without mulching	60.5	8.7	86.9
M_1: With Mulching	64.5	9.7	92.4
SEm (.±)	1.2	0.1	1.7
C.D (5%)	3.7	0.5	5.1
Treatment combinations			
$I_1 F_1 M_0$	61.5	9.5	87.9
$I_1 F_1 M_1$	66.4	10.3	98.7
$I_1 F_2 M_0$	59.0	8.2	83.3
$I_1 F_2 M_1$	62.5	9.3	91.7
$I_1 F_3 M_0$	55.8	7.8	78.9
$I_1 F_3 M_1$	57.4	8.6	80.4
$I_2 F_1 M_0$	68.8	9.6	96.7
$I_2 F_1 M_1$	74.3	11.6	102.8
$I_2 F_2 M_0$	62.5	9.4	91.5
$I_2 F_2 M_1$	66.7	9.8	93.3
$I_2 F_3 M_0$	55.9	8.2	83.3
$I_2 F_3 M_1$	59.6	8.8	87.7
SEm (.±)	3.1	0.4	4.2
C.D (5%)	NS	NS	NS

of more yield was obtained and less evaporation losses from soil surface (Solanki *et al*., 2019). Savani *et al*. (2017) reported that the water use efficiency obtained under irrigation levels of 0.4, 0.6 and 0.8 CPE through drip and surface irrigation were 3.65, 3.02, 2.45 and 1.90 kg ha-mm^{-1} of water used, respectively. This indicated that WUE decreased with increase in level of irrigation. Drip irrigation scheduled at lower level (0.4 CPE) recorded higher WUE of 3.65 kg ha-mm^{-1} with 49 per cent water saving.

Effect of drip fertigation and mulching on nutrients uptake of pigeonpea

The data concerning to nutrient uptake of major nutrients by pigeonpea at harvest as influenced by drip fertigation and mulching and their interactions are presented in Table 3 and 3.1. The uptake of the nutrients by pigeonpea have shown significant effect at the time of harvest. Higher irrigation level 0.75 CPE recorded significantly higher uptake of nitrogen, phosphorous and potassium by crop (64.6, 9.5 and 92.5 kg ha^{-1}, respectively) and it was followed by lower level of irrigation 0.50 CPE (60.4, 8.9 and 86.8 kg ha^{-1}, respectively). Among different levels of fertigation, the higher uptake of nitrogen, phosphorous and potassium was recorded with 100 per cent RDF (67.7, 10.2 and 96.5 kg ha^{-1}, respectively) compared to lower levels of fertigation. Higher uptake of nitrogen, phosphorous and potassium by pigeonpea was observed with mulching (64.5, 9.7 and 92.4 kg ha^{-1}, respectively) compared to without mulching (60.5, 8.7 and 86.9 kg ha^{-1}, respectively). This was due to ready availability of major nutrients in available form near crop root zone because of optimum moisture at higher level of irrigation and crop microclimate was maintained by mulching with higher level of fertility. The interaction effect of different factors recorded non-significant results of nutrients uptake. The similar findings were recorded by Shankarlingappa *et al*. (2000) and Chaudhary *et al*. (2010).

CONCLUSION

The increasing human population day by days needs higher pulse production for satisfying the nutritive protein requirements. We are celebrating international pulse years 2016 and we will produce more amounts of pulses in upcoming centuries. Based on the above investigation it can be concluded that application of treatment combination (I_2 F_1 M_1) 0.75 CPE + 100 per cent RDF gives higher plant growth, yield attributes, yield and productivity with saving of natural resources and enhance the use efficiencies.

REFERENCES

Anonymous. (2018). Annual Report Directorate of Pulse Development, Ministry of Agriculture and Family Welfare, Government of India. pp. 38-39.

Chaudhari, P.R., Wani, P.V., Bachkar, C.B and Bhalerao, V.K. (2010). Response of pigeonpea to phosphate solubilizing biofertilizers. Journal of Maharashtra Agricultural Universities 35(2): 238-40.

FAOSTAT, (2008). Online agricultural statistics. www.faostat.org

Kamar, S.S.A., Khan, M.H. and Uddin, M.S. (2018). Effect of irrigation and mulch on maize yield (*Zea mays*) in southern areas of Bangladesh. J. Agri. Crop Res. 6(2): 28-37.

Kumar, R., Pal, R., Kumar, R., Sagar, S. and Ankur, S.B. (2016). Response of water use efficiency through fertigation on growth and yield of chilli crop. Inter. J. Engi. Sci. and Res. Tech. 5(12):

Mathukia, R.K., Mathukia, P.R. and Polara, A.M. (2015). Effect of preparatory tillage and mulch on productivity of rainfed pigeonpea [*Cajanus cajan* (L.) Millsp.]. Ind. J. Dryland Agric. Res. and Dev. 30(2): 58-61.

Patel, A.R., Gohel, T.J., Davara, D.K. and Solanki, M.H. (2015). Effect of drip irrigation and mulching on growth, yield and water use efficiency of *rabi* pigeonpea (*Cajanus cajan* L.). Trends in Biosciences. 8(16): 4275-4279.

Ramana, Rao, K.V., Aherwar Pushplata, Gangwar, S., Kumar, S. and Yadav, D. (2018). Growth, yield, economics, water use efficiency and microbial functions of pigeonpea crop influenced by drip irrigation with plastic mulch. Inter. J. Curr. Microbiol. App. Sci. 7(12): 2284-2290.

Shankaralingappa, B.C., Shivraj, B., Sudhir, K and Vishwanatha, K.P. (2000). Interaction effect of phosphorus and sulphur on uptake of nitrogen, phosphorus, potassium and sulphur by Pigeonpea. Indian Journal of Agronomy. 45: 348-352.

Shirgapure, K.H. and Fathima, P.S. (2018). Growth and yield of pulses as influenced by irrigation levels in southern dry zone of Kanataka. J. Pharmacognosy and Phytochem. 7(1): 2444-2448.

Solanki, M.A., Chalodia, A.L., Fadadu, M.H. and Dabhi, P.V. (2019). Response of pigeonpea to drip irrigation and mulching. Inter. J. Curr. Microbiol. App. Sci. 8(2): 91-97.

Savani N.G., Patel R.B. Solia B.M., Patel J.M. and Usadadiya V.P. (2017). Productivity and profitability of *rabi* pigeonpea increased through drip irrigation with mulch under south Gujarat condition. Inter. J. Agri. Innov. Res. 5(5): 2319-1473.

Swathi, Y.M., Srinivasa Reddy, Prabhakara, G.R. and Kavitha, P. (2018). Efficacy of polythene mulch technology in improving growth, flowering behavior and yield of irrigated pigeonpea in Andhra Pradesh. Inter. J. Curr. Microbiol. and App. Sci. 6: 1769-1773.