Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2018; 7(2): 2914-2918
Received: 15-01-2018
Accepted: 16-02-2018

AK Saini
Assistant Research Scientist, Centre for Natural Resources Management, Sadarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Gujarat, India

AM Patel
Chief Agronomist, Centre for Research on IFS, SDAU, Sadarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Gujarat, India

PP Chaudhary
Associate Research Scientist, Directorate of Research, Sadarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Gujarat, India

LH Saini
Assistant Research Scientist, Main Sorghum Research Station, Navsari Agricultural University, Surat, Gujarat, India

Correspondence
AK Saini
Assistant Research Scientist, Centre for Natural Resources Management, Sadarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Gujarat, India

Impact assessment of irrigation, fertility and hydrogel levels on growth attributes, yield and economics of summer pearl millet (*Pennisetum glaucum* L.) under North Gujarat conditions

AK Saini, AM Patel, PP Chaudhary and LH Saini

Abstract
A field experiment was conducted during the summer seasons of 2015 and 2016 on loamy sand soils of Agronomy Instructional Farm, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Gujarat to assess the impact of irrigation, fertility and hydrogel levels on growth attributes and yield of summer pearl millet [*Pennisetum glaucum* (L.) R. Br.]. The experiment was laid out in a split plot design with 3 replications, consisted of 3 irrigation levels [0.8, 1.0 and 1.2 irrigation water : cumulative pan evaporation ratio (IW: CPE)], 2 fertility levels (120 : 60 : 00 and 150 : 75 : 00 kg N : P_2O_5 : K_2O/ha) in main plots and 3 hydrogel levels (0.0, 2.5 and 5.0 kg/ha) in sub-plots. The pooled results indicated that irrigation at 1.2 IW/CPE being at par with 1.0 IW/CPE enhanced growth parameters *viz.,* plant height, number of effective and non effective tillers, dry matter production, CGR and RGR and yield of pearl millet. Application of 150: 75: 00 kg N : P_2O_5 : K_2O/ha (125% RDF) significantly improved growth parameters, seed yield, stover yield and harvest index over 100 % RDF (120 : 60 : 00 kg N : P_2O_5 : K_2O/ha). Higher grain yield was a reflection of higher plant height, effective tillers/m, total dry-matter production, grain yield, stover yield and harvest index of pearl millet under application of 5.0 kg hydrogel/ha. Grain yield was found to be significantly and positively correlated to growth *viz.*, plant height (R^2 = 0.858), number of tillers/plant (R^2 = 0.722), dry matter production (R^2 = 0.921) and CGR (R^2 = 0.858); similarly correlation studies between growth and yield showed positive association among themselves. Therefore, irrigation at 1.0 IW/CPE, fertilizer dose of 150 : 75 : 00 kg N : P_2O_5 : K_2O/ha and hydrogel @ 5.0 kg/ha could be applied for higher growth attributes and yields of pearl millet for appreciable saving of water and fertilizers in summer season.

Keywords: pearl millet, irrigation, fertility levels, hydrogel

Introduction
India is the largest producer of pearl millet, the crop occupied an area of 8.69 million hectares, annual production of 10.05 million tonnes with an average productivity of 1156 kg/ha while in Gujarat state, pearl millet occupied an area of 9.32 lakh hectares with the production of 10.97 lakh tonnes and with the productivity of 1177 kg/ha during 2015-16 (Anonymous, 2016) [1].
Irrigation water is becoming scarce and the world is looking for water efficient agriculture. Increasing food demand and declining water resources are challenges for food security (Kreye *et al*., 2009) [9]. The issue of water management has assumed paramount importance and occupied the centre stage of politico-economic debates in the world. Scheduling irrigation on the basis of evaporative demand results not only in efficient utilization of water but also in considerable saving of water. New method in science of soil and water is using super absorbent materials (hydrogels) as reservoirs and prevention from water wastage and increase of irrigation efficiency (Bedi *et al*., 2004) [4]. The water absorbing products like hydrogel may be used as soil amendment to enhance water use efficiency (Huttermann, 2006) [7]. The growth of plants and their quality are mainly a function of the availability of fertilizer and water. Fertilizer use efficiency is closely related to soil moisture content. Inadequate or excess supply of any plant nutrient limits the crop production. To increase the agriculture production, there has been a tendency to apply higher level of fertilizers and irrigation water, often together (Hussain and Al-Jaloud, 1995) [6]. The optimum doses of nutrients for different crops were determined to the decades ago, but thereafter, the fertility status, crop varieties and other inputs have undergone a considerable change, so there is a need to give a fresh look to fertilizer requirement of pearl millet in the light of introduction of hybrids which has the potential yielding ability. Integration of irrigation with fertilizer management has great importance for achieving optimum and sustainable yields of pearl millet. Keeping these considerations in view, an experiment was

carried out to study the effect of irrigation, fertility and hydrogel levels on growth parameters and yield of summer pearl millet.

Materials and Methods

A field experiment was conducted at the Agronomy Instructional Farm, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar (24º19' N, 72º19' E, 154.52 m above the mean sea-level), banaskantha, Gujarat during summer seasons of 2015 and 2016 to study the effect of irrigation, fertility and hydrogel levels on summer pearl millet. The site of experiment is situated in the North Gujarat Agro-climatic Zone IV (AES-I) of Gujarat under Gujarat plains and hills zone of India. The climate of this region is semi-arid and sub-tropical with fairly dry and hot summer. The rainy season commences in the second fortnight of June and ends in August, with an average annual rainfall of 638 mm. July and August are the peak months of rainfall. Partial failures of monsoon once in three to four years are common occurrence in this region. Summer season commences in the second fortnight of March and ends in the middle of June. April and May are the hottest months of summer with the mean maximum temperature ranging from 32ºC to 44ºC. During crop season of the year 2015, the minimum temperature ranged from 14.8ºC to 27.1ºC, maximum temperature ranged from 30.1ºC to 41.2ºC and daily pan evaporation ranged from 3.2 to 13.5 mm/day, while in the year 2016, the minimum temperature ranged from 17.6ºC to 27.7ºC, maximum temperature ranged from 34.1ºC to 45.2ºC and daily pan evaporation ranged from 3.8 to 11.2 mm/day. The weather parameters, viz. mean relative humidity, wind velocity and sunshine hours were normal during both the years of experiment period. The off season rainfall was not received during the crop period. In general, the weather conditions were congenial during crop season of both the years. The experimental site had an even topography with a gentle slope and good drainage. The experimental soil was loamy sand (83.90% sand, 5.55% silt and 9.84% clay) in texture and slightly alkaline in reaction with *p*H 7.41 and ECe 0.13 dS/m. It was moderately fertile being low in organic carbon (2.5 g/kg) and low in available nitrogen (167.5 kg/ha), medium in available phosphorus (39.5 kg/ha) and high in available potassium (269.5 kg/ha). Besides, initial bulk densities of the soil were 1.44 and 1.45Mg/m^3 in 0–15 and 15–30 cm depth respectively. The eighteen treatment combinations consisted of three levels of irrigation [0.8, 1.0 and 1.2 irrigation water: cumulative pan evaporation ratio (IW: CPE)], 2 fertility levels (120: 60: 00 and 150: 75: 00 kg N: P_2O_5 : K_2O/ha) in main plots and 3 hydrogel levels (0.0, 2.5 and 5.0 kg/ha) as sub-plots treatments were evaluated using split-plot design with 3 replications. The field plots of size 5.0 m × 4.5 m were separated from each other by using 1 m buffer rows. The measured quantity of fertilizers and hydrogel was drilled in the soils at 5 cm below the seed according to treatments. 'Gujarat Hybrid Bajara 732' was selected for the present investigation. It has attractive seed colour and bold seed size. The seeds were sown keeping 45 cm row spacing using 3.75 kg seeds/ha on 02 and 01 March during 2015 and 2016 respectively. The crop was irrigated immediately after sowing during both the years. Thereafter, irrigation was given as per treatment schedule based on irrigation water: cumulative pan evaporation ratio (IW: CPE). The excess plants were thinned out at 20 days after sowing (DAS) keeping within row distance at 15 cm for maintaining uniform plant stand. The required cultural practices were followed as per recommended package. Weeds were managed by two weeding at 25 and 45 DAS and an intercultural operation with hand hoe at 25 DAS. The quantity of irrigation water applied in each experimental plot was measured with a 7.5 cm throat size Parshall flume installed in the main water channel near the field head. The cumulative pan evaporation (CPE) values were calculated from daily pan evaporation measured with the help of USWB Class 'A' open pan evaporimeter installed at the meteorological observatory of the farm. Irrigations were applied as per treatment on the basis of IW: CPE approach using 50 mm depth of irrigation water. Time for applying the measured quantity of irrigation water to each plot was calculated using the standard equation. The soil moisture studies were started from sowing of crop and continued up to its maturity. The soil moisture content of all the treatments was determined on same day just before irrigation and 48 hours after irrigation at 0–15, 15–30, 30–45 and 45–60 cm soil depth. The data obtained on moisture percentage in each depth were used for calculating seasonal consumptive use of water for pearl millet. The depth of water table was more than fifty meters below the surface throughout the period of experimentation. The total number of irrigations required were 9, 11 and 13 during 2015 and 11, 13 and 15 during 2016 for 0.8, 1.0, and 1.2 IW: CPE, respectively excluding the one common irrigation provided for sowing and better establishment during both the years of experiment. The evapotranspiration observed during growing seasons of 2015 and 2016 were 664.7 and 757.0 mm respectively. The crop was harvested on 30 and 29 May during 2015 and 2016, respectively. The plant height and tillers/plant were recorded from five selected plant at 30, 60 DAS and at harvest from each plot. Penultimate rows of each plot were used for recording dry matter accumulation at 30, 60 DAS and at harvest. For dry-matter accumulation, plant material first air dried, then chopped and oven dried at 70ºC for 72 hrs to a constant weight. The yield attributes, viz. number of ear heads, girth of earhead, length of earhead, grains weight/earhead and 1000-grain weight were recorded at the time of harvesting. The crop was harvested manually with the help of sickle when seed almost matured and stover had turned yellow. The sun dried bundles were threshed and winnowed and seed so obtained were weighed and data on seed and stover yields were recorded. Harvest Index (HI) was calculated by dividing the seed yield with biological yield. The economics of the treatments was carried out on the basis of prevailing market prices of inputs and outputs. Gross returns were calculated based on the seed and stover yields of the crop and their prevailing market prices during the respective crop seasons. Net returns were calculated by subtracting cost of cultivation from gross returns. The benefit: cost ratio was calculated by dividing the net returns with cost of cultivation. The statistical analysis of data was done using analysis of variance (ANOVA) technique for split plot design at 0.05 probability level.

Results and Discussion

Growth parameters

Significantly higher plant height at 30, 60 days after sowing (DAS) and at harvest was recorded at an IW: CPE of 1.2 over IW: CPE of 0.8 and 1.0. The increase in the plant height and might be due to optimum supply of soil moisture surrounding the root zone, which cause favourable improvement in the uptake and translocation of the nutrients and ultimately linked with the plant growth and development in terms of plant height. Increased plant height with increasing level of irrigation was also reported by Patel *et al.* (2013) [14]. Application of irrigation at an IW: CPE of 1.2 recorded significantly higher number of effective tillers and lowest number of non effective tillers over rest of irrigation levels IW: CPE of 0.4 and 0.6 but remained at par with 0.8 IW: CPE.

Among the treatments during all the growth stages the performance of pearl millet crop in terms of dry matter was significantly different and it was in the decreasing order of 1.2 IW : CPE > 1.0 IW : CPE > 0.8 IW : CPE treatments during all the stages of growth in pooled analysis. Improved growth in terms of dry-matter accumulation at 30, 60 DAS and harvest was attained with higher IW: CPE of 1.0 and 0.8. As water is not a limiting factor, plant can absorb more nutrients from soil, which encourages physiological processes such as cell division and cell expansion. Hence leaves/plant increased and ultimately it reflected in higher dry matter accumulation. The dry-matter is a cumulative effect of all growth parameters like plant height, number of tillers etc. which were significantly more in 1.2 IW: CPE, the resultant dry matter also more. Similar increase in dry matter accumulation with higher level of irrigation was also reported by Pareek *et al*. (2015) [12]. Higher level of irrigation also recorded significantly more crop growth rate and better relative growth rate than lower level of irrigation, could be owing to maintaining its progeny with the available resources.

Fertility levels had also significant effect on plant height at 30, 60 days after sowing (DAS) and at harvest. The higher plant height and effective tillers were recorded under 150:75 kg N: P_2O_5/ha over 120: 60 kg N: P_2O_5/ha, while the lowest non effective tillers was registered under higher fertility level (Table 1). The increase in these components seems to have been brought about by increase in amount of growth substances and naturally occurring phyto hormones with increased fertility supply. Probably the increase in auxin supply with higher levels of fertility brought about increase in the tillers/plant. Application of fertilizer at 150:75 kg N: P_2O_5/ha recorded significantly higher dry matter/plant at 30, 60 DAS and at harvest. Improved dry matter production at higher levels of fertility (125 % RDF) may be attributed to the fact that nutrients being important constituent of nucleotides, proteins, chlorophyll and enzymes, involves in various metabolic processes which have a direct impact on vegetative and reproductive phase of pearl millet plants. Beneficial effects of higher levels of fertility on dry matter production in pearl millet were also reported by Tetarwal and Rana (2007) [16], Kumar *et al*. (2014) [10]. Higher level of fertilizer recorded the maximum crop growth rate at better relative growth rate whereas; the poor growth rates were registered under lower fertility treatment (F_1).

A perusal of pooled data presented in Table 4.2 revealed that plant height was highest with application of 5.0 kg hydrogel/ha while minimum plant height was recorded under no hydrogel application treatment during all the stages of observations. This increase in plant height was due to more retention of moisture and indirectly the availability of nutrients provided by hydrophilic polymer, where it might have helped to increase the activity of cell division, expansion and elongation, ultimately leading to increased plant height. Similar results were also observed by Anupama *et al.* (2005) [2] in chrysanthemum. Table 4.3 showed that the application of hydrogel with varying levels significantly affected the production of effective and non effective tillers. Similarly, data presented in Table 4.4 revealed that dry matter accumulation was highest with application of 5.0 kg hydrogel/ha while no hydrogel application (treatment H_0) registered lowest dry matter production during all the stages of observations. Application of hydrogel @ 5.0 kg/ha also registered highest CGR and RGR on pooled basis. Dry matter production indicated the maintenance of dry matter production over a particular period of time which is very much essential for prolonged supply of photosynthates to the developing sink. Significantly higher dry matter production value was recorded in polymer treated soil at all stages of crop. This suggested that super absorbent polymer resulted in increased dry matter production, CGR and RGR. Polymers improve water holding capacity and nutrient supplying capacity of soil which ultimately improve growth and dry matter production of plants (El-Hady *et al*., 1981) [5].

Table 1: Growth attributes of summer pearl millet as influenced by irrigation, fertility and hydrogel levels (pooled mean of 2 years)

Treatments	Plant height (cm)			Tillers/plant	
	30 DAS	60 DAS	At harvest	Effective	Non effective
Main Plot A. Irrigation levels					
I_1 : 0.8 IW : CPE	42.5	112.3	145.8	2.21	1.43
I_2 : 1.0 IW : CPE	55.9	140.8	181.8	2.32	1.00
I_3 : 1.2 IW : CPE	68.4	152.9	191.7	2.37	0.88
S.Em. ±	0.8	1.9	2.4	0.027	0.029
C.D. at 5 %	2.3	5.4	7.0	0.077	0.083
Main Plot B. Fertility levels					
F_1 : 100 % RDF	50.4	129.6	167.3	2.10	1.24
F_2 : 125 % RDF	60.8	141.1	179.0	2.51	0.97
S.Em. ±	0.7	1.5	2.0	0.022	0.023
C.D. at 5 %	1.9	4.4	5.7	0.063	0.068
Sub Plot C. Hydrogel levels					
H_0 : No Hydrogel	49.3	128.9	166.4	2.23	1.14
H_1 : 2.5 kg/ha	54.7	134.3	172.3	2.32	1.12
H_2 : 5.0 kg/ha	62.8	142.9	180.6	2.36	1.06
S.Em. ±	0.3	0.9	1.1	0.016	0.012
C.D. at 5 %	0.9	2.4	3.2	0.045	0.033

Table 2: Growth attributes of summer pearl millet as influenced by irrigation, fertility and hydrogel levels (pooled mean of 2 years)

Treatments	Dry matter accumulation/plant (g)			CGR (g m^{-2} day^{-1})	RGR (g g^{-1} day^{-1})
	30 DAS	60 DAS	At harvest	At 30-60 DAS	At 30-60 DAS
Main Plot A. Irrigation levels					
I_1 : 0.8 IW : CPE	2.22	34.30	66.65	26.73	0.0913
I_2 : 1.0 IW : CPE	4.83	39.87	76.12	29.20	0.0703

I_3 : 1.2 IW : CPE	5.60	43.30	83.86	31.42	0.0681
S.Em. ±	0.030	0.639	0.623	0.511	0.0004
C.D. at 5 %	0.086	1.839	1.794	1.471	0.0010
Main Plot B. Fertility levels					
F_1 : 100 % RDF	3.97	36.75	72.66	27.31	0.0767
F_2 : 125 % RDF	4.46	41.56	78.42	30.92	0.0764
S.Em. ±	0.024	0.521	0.508	0.417	0.0003
C.D. at 5 %	0.071	1.502	1.465	1.201	NS
Sub Plot C. Hydrogel levels					
H_0 : No Hydrogel	4.14	38.34	70.03	28.49	0.0765
H_1 : 2.5 kg/ha	4.23	39.11	75.31	29.07	0.0764
H_2 : 5.0 kg/ha	4.27	40.02	81.29	29.79	0.0768
S.Em. ±	0.021	0.302	0.403	0.245	0.0003
C.D. at 5 %	0.058	0.852	1.137	0.691	NS

Table 3: Yield and Harvest index of pearl millet as influenced by irrigation, fertility and hydrogel levels (pooled mean of 2 years)

Treatments	Number of earhead/ metre	Length of earhead (cm)	Girth of earhead (cm)	Grain weight/earhead(g)	1000-grain weight (g)
Main Plot A. Irrigation levels					
I_1 : 0.8 IW : CPE	13.92	19.02	9.03	11.50	12.10
I_2 : 1.0 IW : CPE	14.85	23.80	11.25	12.38	12.28
I_3 : 1.2 IW : CPE	15.64	24.72	12.76	13.00	12.44
S.Em. ±	0.403	0.354	0.120	0.217	0.038
C.D. at 5 %	1.160	1.020	0.346	0.626	0.109
Main Plot B. Fertility levels					
F_1 : 100 % RDF	13.44	21.45	10.46	11.77	12.20
F_2 : 125 % RDF	16.32	23.58	11.56	12.82	12.35
S.Em. ±	0.329	0.289	0.098	0.177	0.031
C.D. at 5 %	0.947	0.832	0.282	0.511	0.089
Sub Plot C. Hydrogel levels					
H_0 : No Hydrogel	14.05	21.74	10.77	11.78	11.55
H_1 : 2.5 kg/ha	14.85	22.54	11.02	12.55	12.26
H_2 : 5.0 kg/ha	15.34	23.27	11.24	12.65	13.02
S.Em. ±	0.200	0.174	0.073	0.136	0.032
C.D. at 5 %	NS	0.490	0.205	0.383	0.090

Table 4: Yield and Harvest index of pearl millet as influenced by irrigation, fertility and hydrogel levels (pooled mean of 2 years)

Treatments	Grain yield (kg/ha)	Stover yield (kg/ha)	Harvest Index (%)	Net return (/ha)	Benefit : Cost Ratio
Main Plot A. Irrigation levels					
I_1 : 0.8 IW : CPE	3526	5810	38.00	47691	1.26
I_2 : 1.0 IW : CPE	4209	7152	36.86	63132	1.58
I_3 : 1.2 IW : CPE	4511	8113	35.71	70571	1.67
S.Em. ±	76.9	160.3	0.658	1640	0.040
C.D. at 5 %	322	981	NS	4725	0.116
Main Plot B. Fertility levels					
F_1 : 100 % RDF	3789	6628	36.38	54364	1.38
F_2 : 125 % RDF	4375	7422	37.33	66564	1.64
S.Em. ±	62.8	130.3	0.537	1339	0.033
C.D. at 5 %	181	376	NS	3858	0.095
Sub Plot C. Hydrogel levels					
H_0 : No Hydrogel	3683	6577	36.01	55085	1.50
H_1 : 2.5 kg/ha	4076	7017	37.00	60298	1.51
H_2 : 5.0 kg/ha	4488	7480	37.56	66011	1.53
S.Em. ±	68.6	111.3	0.589	1270	0.032
C.D. at 5 %	194	314	NS	3581	NS

Yield

The result with respect to seeds and stover yields indicated that irrigation level had appreciably influenced the seed and stover yields of pearl millet. The irrigation at 1.2 IW: CPE produced significantly highest seed and stover yields as compared to 0.8 IW: CPE and remained at par with IW: CPE of 1.0. The increase in seed yield under 1.2 IW: CPE over 0.8 and 1.0 was 7.17 and 27.93%, while that of stover was 13.43 and 39.63% respectively. The higher seed and stover yields with 1.2 and 1.0 IW: CPE could be attributed to increased soil moisture coupled with accelerated nutrients uptake, which helped the plant to put optimum growth. Increase in seed and stover yields with an application of irrigation at 0.7 IW: CPE was also reported by Sonawane *et al.* (2010). The harvest index of pearl millet was not significantly influenced by irrigation, fertility and hydrogel levels in both the years of study. As a well established fact harvest index is more or less governed by genetical make up of a plant and is not influenced much more by input supply system if crop is raised under recommended practices. Our results also follow the same pattern.

The fertility level 150:75 kg $N:P_2O_5$/ha (125% RDF) produced significantly the highest seed and stover yield as compared to 120:60 kg $N:P_2O_5$/ha. The extent of increase in seed and stover yields under 150:75 kg $N:P_2O_5$/ha was 15.46 and 11.98%

respectively over the 100% RDF. This might be due to adequately fertilized crop benefited from higher rates of nutrition that might have resulted into a more vigorous and extensive root system of crop leading to increased vegetative growth means for more efficient sink formation and greater sink size, greater carbohydrate translocation from vegetative plant parts to the grains and longer and thicker earhead, ultimately reflected in higher grain and stover yield of pearl millet. These findings are corroborating with the results of Parihar *et al*. (2010) [13] and Kumar *et al*. (2014) [10].

Maximum grain yield (4488 kg/ha) and stover yield (7480 kg/ha) was registered under treatment H_2 (hydrogel application @ 5.0 kg/ha) which was significantly superior to the yields obtained under other levels of hydrogel. These results are coinciding with that obtained by Waly *et al*. (2015) [17] in rice. Hydrogel is a hydrophilic or super absorbent polymer has shown the potential to realize more yield per unit of input. Its application to the soil helped in retaining more moisture in the soil, increased water holding capacity of polymer and decreased infiltration rate of soil. Increasing the levels of hydrogel has increased water use efficiency over control.

Economics

The results pertaining to the cost: benefit analysis of the crop as influenced by irrigation levels indicated that application of irrigation at 1.2 IW: CPE recorded the highest net returns (₹ 70,571/ha) with the maximum benefit: cost ratio of 1.67, whereas irrigating at an IW: CPE of 1.0 recorded the at par value of benefit: cost ratio. The higher net returns/ha under 1.2 IW: CPE could be attributed to significantly higher seed and stover yield under this treatment as compared to other levels of irrigation. The results are in concurrence with those reported by Pareek *et al*. (2015) [12]. Fertility level The fertility level 150:75 kg $N:P_2O_5$/ha (125% RDF) produced significantly the highest net returns of ₹ 66564/ha with the highest benefit: cost ratio of 1.64. The higher net gain/ha under 125% RDF could be attributed to significantly higher yields as compared to 100% RDF. The highest net return (₹ 66011/ha) was recorded in the treatment H_2 (5.0 kg hydrogel/ha) while different levels of hydrogel failed to exert any significant effect on benefit: cost ratio. Based on the study it is concluded that summer pearl millet sown in loamy sand soils of Gujarat region with 1.2 IW: CPE recorded the higher seed yield and gained the highest net returns and benefit: cost ratio over all the irrigation treatments. Fertility level 150:75 kg N: P_2O_5/ha and hydrogel level 5.0 kg/ha seems to be optimum for getting higher seed yield and monetary returns. Therefore, irrigation at 1.2 IW: CPE along with application of 150:75 kg $N:P_2O_5$/ha and 5.0 kg/ha hydrogel could be applied for higher yield and economical realization from pearl millet along with appreciable saving of water in summer season.

References

1. Anonymous. Agriculture statistics at a glance. Directorate of Economics and Statistics Ministry of Agriculture, Govt. of India. (Website: http//wwwdacnet.nic.in/eands) 2016, 519.
2. Anupama MC, Singh R, Kumar BS, Kumar PA. Performance of new superabsorbent polymer on seedling and post planting growth and water use pattern of Chrysanthemum under controlled environment. Acta Horticulturae. 2005; 618:215-224.
3. AOAC. Method of Analysis of the Association of Official Agricultural Chemists. Edn 9. Association of Official Agricultural Chemists, Washington, DC, USA, 1960.
4. Bedi KJ, Sohrab F. Evaluation of super absorbent polymer application on water holding capacity and potential in three soil type. Journal of Science and polymer Technology. 2004; 3:163-173.
5. El-Hady OA, Tayel MY, Lotfy AA. Super gel as a soil conditioner, II-Its effects on plant growth, enzyme activity, water use efficiency and nutrient uptake. Acta Horticulturae. 1981; 119:257-265.
6. Hussain G, Al-Jaloud AA. Effect of method of irrigation and nitrogen use efficiency of wheat in Saudi Arabia. Agricultural Water Management. 1995; 21:143-154.
7. Huttermann A, Zommorodi M, Reise K. Addition of hydrogels to soil for prolonging the survival of *Pinus halepensis* seedlings subjected to drought. Soil and Tillage Research. 2006; 50:295-304.
8. Kachhadiya SP, Chovatia PK, Jadav KV, Sanandia ST. Effect of irrigation, mulches and antitranspirant on yield, quality and economics of summer pearl millet. International Journal of Agricultural Sciences. 2010; 6(1):278-282.
9. Kreye C, Bouman BAM, Castaneda AR, Lampayan RM, Faronilo JE, Lactaoen AT, et al. Possible causes of yield failure in tropical aerobic rice. Field Crops Research. 2009; 111:197-206.
10. Kumar P, Singh R, Singh A, Paliwal D, Kumar S. Integrated nutrient management in pearl millet (*Pennisetum glaucum*) – wheat (*Triticum aestivum*) crop sequence in semi arid conditions of India. International Journal of Agricultural Sciences. 2014; 10(1):96-101.
11. Mishra RD, Ahmad M. Manual of Irrigation Agronomy, Oxford and IBH Publication. 1987, 171.
12. Pareek P, Patel MR, Patel HK, Patel PM. Effect of irrigation and N levels on forage yield and quality of pearl millet (*Pennisetum glaucum* (L.) R. Br.). International Journal of Agriculture Sciences. 2015; 11(2):264-267.
13. Parihar CM, Rana KS, Kantwa SR. Nutrient management in pearl millet (*Pennisetum glaucum*)–mustard (*Brassica juncea*) cropping system as affected by land configuration under limited irrigation. Indian Journal of Agronomy. 2010; 55(3):191-196.
14. Patel NH, Patel BM, Patel HB, Patel PM. Effect of irrigation and mulches on summer pearl millet [*Pennisetum glaucum* (l.)] Under north gujarat agro-climatic conditions. AGRES – An International e-Journal. 2013; 2(2):246-249.
15. Sharma PK, Yadav GL, Sharma BL, Kumar S. Response of wheat (*Triticum aestivum* L.) to nitrogen and zinc fertilization. Indian Journal of Agronomy. 2000; 45:124–127.
16. Tetarwal JP, Rana KS. Effect of cropping systems, fertility levels and moisture conservation practices on growth and yield of pearl millet and mothbean in intercropping system. Annals of Agricultural Research. 2007; 28(1):1-6.
17. Waly A, El-Karamany MF, Shaaban AM, Bakry AB, Elewa TA. Utilization of hydrogel for reducing water irrigation under sandy soil condition 2- Preliminary study: yield and yield components of rice and barley in sandy soil as affected by hydrogel. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 2015; 6(2):1018-1024.
18. Yazdani F, Allahadadi I, Akbari GA. Impact of superabsorbent polymer on yield and growth analysis of Soybean (*Glycine max* L.) under drought stress condition. Pakistan Journal of Biological Sciences. 2007; 10(23): 4190-4196.