Forage Res., **48**(1) : pp. 95-98 (2022) **http://forageresearch.in**

YIELD, HARVEST INDEX AND AGRO METEOROLOGICAL INDICES OF PEARL MILLET AS INFLUENCED BY IRRIGATION SOURCES, FYM AND FERTILITY LEVELS

PARVEEN KUMAR[1,]* AND ANIL KUMAR[2]

[1]Department of Agronomy, CCS Haryana Agricultural University, Hisar-125 004 (Haryana), India
[2]Department of Agril. Meteorology, CCS Haryana Agricultural University, Hisar-125 004 (Haryana), India
(e-mail : rohilaparveen@gmail.com)

(Received : 01 June 2022; Accepted : 25 June 2022)

SUMMARY

A field experiment was conducted at Vegetable Research Farm, Chaudhary Charan Singh Haryana Agricultural University; Hisar to study the influence of irrigation sources, FYM and fertility levels on yield, harvest index and agrometeorological indices of pearlmillet.The experiment consisted of 16 treatment combinations with two irrigation sources [canal and treated sewage water], two levels of farm yard manure [2.5 and 5 t/ha] that assisted in main plots and four fertility levels [control, 50, 75 and 100% RDF (recommended dose of fertilizer, 156.25 kg N and 62.5 kg P_2O_5/ha)] that assisted in subplots in split-plot design using three replications. Irrigation sources (canal and treated sewage water) did not differ significantly in respect of yield and agrometeorological indices*viz.*thermal, heliothermal and photothermal use efficiencies. Significantly higher value of thermal, heliothermal and photothermal use efficiencies in respect of seed and stover yield were found with the application of 100 percent recommended dose of fertilizers (RDF) over control and 50 percent RDF. Neither the irrigation sources nor the fertility levels brought any significant variation in respect of attraction and harvest index of pearlmillet.

Key words : Yield, pearlmillet, irrigation sources, FYM levels, sewage and canal water

Pearl millet is an important nutri-cereal that plays a dominant role in integrated agricultural and animal husbandry economy of the drier region of the country (Chaudhary *et al.*, 2015). Its tolerance to drought, high temperature, low soil fertility, rapid growth rate when conditions are favourable and ability to extract mineral nutrition and water even from the poorest soils make it impossible to beat the pearl millet in growing it in the world's hardest agricultural production environment (Manjeet and Kumar 2017). Though adapted to resource-poor situation, as crop is hardy, require less water and has a short-growing period. Hence, the growth rate of this crop has been as high as wheat and much higher than other coarse cereals, like maize and sorghum in the last few decades, mostly due to introduction of high yielding disease-resistant varieties. Pearl millet crop production suffers badly due to low soil fertility and scarce water availability, thereby reducing the yield potential (Kumar *et al.*, 2012). Moreover, the availability of good quality irrigation water is declining day by day, the water constraint may be overcome with irrigating the crop with poor quality water like treated sewage water. Supplemental water sources, especially sewage water, are the possible solution to the global problem of shortage of irrigation water in crop production. The value of wastewater for crop production has been widely recognized in India and other water-scarce regions.Temperature plays a vital role in growth and development of crop plants by regulating their physiological, chemical and biological processes (Yadav *et al.,* 2016). Hence, Crop growth and development are often correlated with thermal unit indices, like growing degree days (GDD), photo-thermal units (PTU), helio-thermal units (HTU), pheno-thermal index (PTI) and heat use efficiency (HUE).These indices relate temperature and sunshine hours to cropgrowth and dry matter production that can be used effectivelyfor prediction of growth, phenology and yield of crops based on weather parameters (Kingra and Prabhjyot-Kaur, 2013;Singh *et al.,* 2014). Among the above indices, GDD is an essential tool that used to identify theadverse effect of temperature and also find out the timing of different biological process.

MATERIALS AND METHODS

A field experiment was carried out at

Vegetable Research Farm, Chaudhary Charan Singh Haryana Agricultural University; Hisar located in Indo-Gangetic Plains of North-West India with latitude of $29^0 10'$ North and longitude of $75^0 46'$ East at 215.2 meters above mean sea level during *kharif* 2018 and 2019. The soil of the experimental site was sandy loam in texture, slightly alkaline in reaction, low in organic carbon, available nitrogen, medium in available phosphorus and high in available potassium. The climate is semiarid and subtropical, hot and dry summer with mean rainfall of 400 mm. Rainfall being monsoonal in nature, 70-80% is received during the months of July, August and September, which coincides with the active growing season of pearl millet. The maximum temperature varied between 28.2 to 40.4°C with an average of 34.9°C in the *Kharif* season of 2018 and 27.9 to 39.1°C in the *Kharif* season of 2019 with average of 34.4°C. The experiment consisted of 16 treatment combinations with two irrigation sources [canal and treated sewage water], two levels of farm yard manure [2.5 and 5 t/ha] that assisted in main plots and four fertility levels [control, 50, 75 and 100% RDF (recommended dose of fertilizer, 156.25 kg N and 62.5 kg P_2O_5/ha)] that assisted in subplots in split-plot design using three replications. The pre-sowing irrigation was applied through canal water, and the seed bed was prepared at field capacity. Pearl millet hybrid 'HHB 197' was sown by drilling in rows using 5 kg seed /ha. The farm yard manure was applied 15 days before sowing as per treatment. Full dose of phosphorus and half dose of nitrogen were applied as per the treatments at the time of sowing and rest of the nitrogen was top dressed in two equal splits one after thinning and gap filling and another at ear head formation. Urea (46% N) and single super phosphate (16% P_2O_5) were used as the sources of nitrogen and phosphorus, respectively. Different agro-meteorological indices and heat-use efficiencies were calculated using following equations on daily basis and accumulated from sowing to harvesting taking10°C as base temperature as given by (Kumar *et al* 2021). Growing degree-days from sowing to crop maturity/ harvesting were intended by summation of daily mean temperature above base temperature (10°C) for corresponding period.

$$\text{GDD} = \sum_{i}^{n} [\{\frac{Tmax + Tmin}{2}\} - Tb$$

Where T_{max} and T_{min} are daily maximum and minimumtemperature; Tb is the base temperature; n is the number of days required to attain crop maturity.

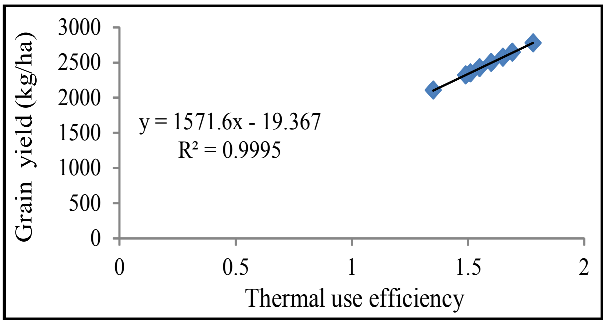

Fig. 1. Thermal use efficiency and grain yield.

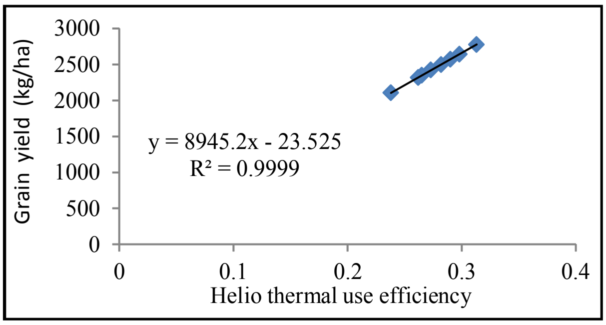

Fig. 2. Helio thermal use efficiency and grain yield.

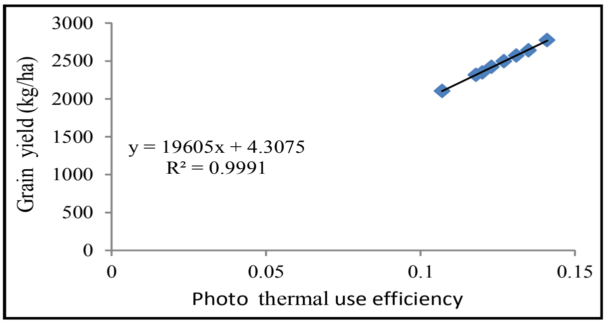

Fig. 3. Photo thermal use efficiency and grain yield.

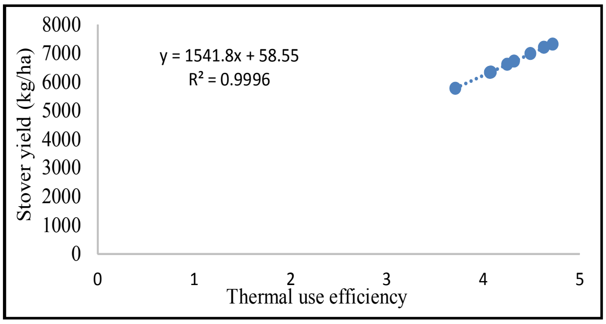

Fig. 4. Thermal use efficiency and stover yield.

Heliothermal unit (HTU) for crop maturity was calculatedby using the formula as :

HTU (^{0}C day hr) = GDD × Bright Sunshine hours

Photothermal unit (PTU) for crop maturity was calculatedas:

PTU (^{0}C day hr) = GDD × maximum possible day length at the experiment site.

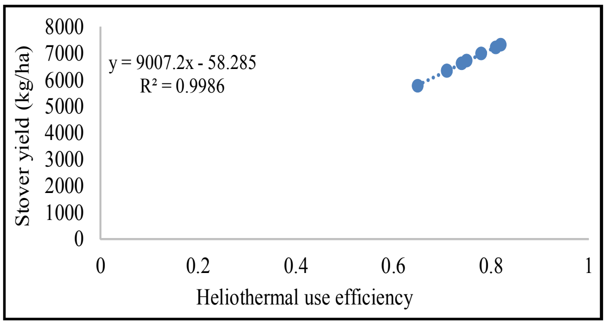

Fig. 5. Heliothermal use efficiency and stover yield.

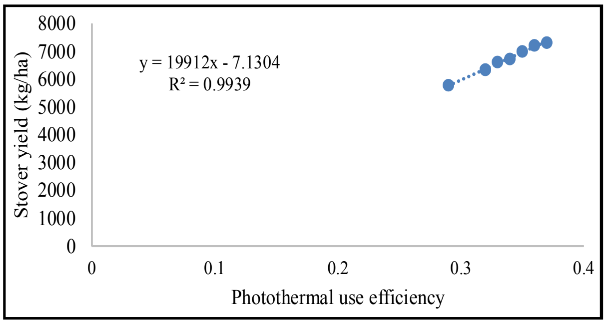

Fig. 6. Photothermal use efficiency and stover yield.

Thermal-use efficiency (TUE) is the extent of above ground dry matter formed per degree-day. It was intendedby using the following formula:

TUE (kg/ha/^{O}C day) = Seed or stover yield (kg/ha) /Accumulated GDD

HTUE (kg/ha degree-day hr.) = Seed or stover yield (kg/ha) /Accumulated HTU

PTUE (kg/ha degree-day hr.) = Seed or stover yield (kg/ha)/Accumulated PTU

The data were pooled and were subjected to analysis of variance using online statistical analysis package of OPSTAT (Sheoran *et al.* 1998).

RESULTS AND DISCUSSION

The irrigation sources, *viz.* canal and treated sewage water, did not differ significantly in respect of stover and biological yield of pearl millet. However, the higher values of these parameters were recorded under canal irrigation treatment. Between FYM levels, significantly higher stover and biological yield were recorded with the application of FYM @5 t/ha over 2.5t/ha. Among fertility levels, significantly higher stover and biological yield were found with the application of 100 percent RDF over control and 50 percent RDF, however, it did not differ significantly from the treatment 75 percent RDF. Higher yield with higher levels of FYM and RDF might be due to improved soil properties and adequate nutrient supply

TABLE 1

Effect of irrigation sources and fertility levels on yield, attraction and harvest index of pearl millet (pooled of two years)

Treatment	Yield (kg/ha)		Attraction (%)	Harvest (%)
	Stover	Biological		
Irrigation sources				
Canal water	6722	9220	36.6	27.19
Treated sewage water	6614	9037	36.7	26.69
CD (p=0.05)	NS	NS	NS	NS
FYM levels				
FYM 2.5 t/ha	6346	8694	37.3	27.02
FYM 5.0 t/ha	6990	9563	37.0	26.86
CD (p=0.05)	281	251	NS	NS
Fertility levels				
Control	5777	7883	36.5	26.62
50% RDF	6331	8649	36.9	26.83
75% RDF	7212	9855	36.9	26.77
100% RDF	7315	10127	38.2	27.54
CD (p=0.05)	362	359	NS	NS

that ultimately results in higher growth parameters. However, when its supply is suboptimal, the growth may remain retarded, which maybe attributed directly to nutritional effect. Neither the irrigation sources nor the fertility levels bring any significant variation in respect of attraction and harvest index of pearlmillet. Similar trend was observed between FYM levels in respect of attraction and harvest index (Table 1).Heat use efficiency, heliothermal use efficiency and photothermal use efficiency determine the ability of a plant to convert per unit available energy into the economic product. The data presented in Table 2 revealed that the GDD, HTU and PTU values recorded were 1555, 8860 and 19640 respectively. The canal and treated sewage water did not differ significantly in respect of thermal, heliothermal and photothermal use efficiencies. However, higher values were observed under canal irrigation treatment. Between FYM levels, significantly higher values of these efficiencies were found with the application of FYM 5 t/ha as compared to 2.5 t/ha. Among fertility levels, significantly higher value of thermal, heliothermal and photothermal use efficiencies in respect of grain yield were found with the application of 100 percent recommended dose of fertilizers (RDF) over control, 50 and 75 percent RDF. However, 75 percent RDF and 100 percent RDF treatment did not differ significantly in respect of photothermal use efficiency. Similarly, significantly higher values of thermal, heliothermal and photothermal use efficiencies in respect of stover yield were found with the application of 100 percent recommended dose of fertilizers (RDF) over lower levels except 75 percent

TABLE 2

Effect of irrigation sources and fertility levels on agrometeorological indicesof pearl millet (pooled of two years)

Treatment	GDD (°C	HTU (°C day hr.)	PTU (°C day hr.)	Thermal use efficiency (kg/ha/°C day)		Heliothermal use efficiency (kg/ha/°C day hr.)		Photothermal use efficiency (kg/ha/°C day hr.)	
				Grain	Stover	Grain	Stover	Grain	Stover
Irrigation source									
Canal water	1555	8860	19640	1.60	4.32	0.282	0.75	0.127	0.34
Treated sewage water	1555	8860	19640	1.55	4.25	0.273	0.74	0.123	0.33
CD (p=0.05)	-	-	-	NS	NS	NS	NS	NS	NS
FYM levels									
FYM 2.5 t/ha	1555	8860	19640	1.51	4.08	0.265	0.71	0.120	0.32
FYM 5.0 t/ha	1555	8860	19640	1.65	4.49	0.290	0.78	0.131	0.35
CD (p=0.05)	-	-	-	0.05	0.18	0.009	0.03	0.004	0.01
Fertility levels									
Control	1555	8860	19640	1.35	3.71	0.238	0.65	0.107	0.29
50% RDF	1555	8860	19640	1.49	4.07	0.262	0.71	0.118	0.32
75% RDF	1555	8860	19640	1.69	4.63	0.298	0.81	0.135	0.36
100% RDF	1555	8860	19640	1.78	4.72	0.313	0.82	0.141	0.37
CD (p=0.05)	-	-	-	0.08	0.23	0.014	0.04	0.006	0.01

RDF. This was due to greater vegetative growth which resulted in more dry matter accumulation and ultimately more yield caused by increasing levels of fertility. Correlation coefficient calculated between grain yield and agrometeorological efficiencies; stover yield and agrometeorological efficiencies revealed a strong and positive correlation between yield and agrometeorological efficiencies (Fig. 1 to 6).

CONCLUSION

Based on the study it is concluded that canal and treated sewage water did not differ significantly in respect of yield (stover as well as biological)and agrometeorological indices of pearlmillet crop.Higher levels of FYM and fertility produced higher yield over lower levels.

REFERENCES

Chaudhary, S., P. Sagar, B.K. Hooda, R.K. Arya, 2015: Multivariate analysis of pearl millet data to delineate genetic variation. *Forage Res.* **40** (4): 201-208.

Kingra, P.K. and Prabhjyot-Kaur, 2013: Agroclimatic studyfor prediction of growth and yield of Brassica sp. in central Punjab. *J. Agric. Phys.*, **13**(2): 148-152.

Kumar, A., R.K. Arya, S. Kumar, D. Kumar, S. Kumar, R. Panchta, 2012: Advances in pearl millet fodder yield and quality improvement through breeding and management practices. *Forage Res.* **38** (1): 1-14.

Kumar, P., S.K.Sharma, A.Kumar and S.K. Thakral, 2021: Agro-meteorological indices and productivity of chickpea (*Cicer arietinum*) under dryland condition as influenced by seed priming and chemi-biofertilizers. *Indian J. Agron.,***66** (1): 46-50.

Manjeet and P. Kumar 2017. Influence of manure and nitrogen levels on nutrient uptake, soil fertility and economics of pearlmillet under semiarid environment. *Forage Res.,***43** (3): 208-212.

Sheoran O.P., D.S.Tonk, L.S.Kaushik, R.C.Hasija, R.S.Pannu, 1998:Statistical Software Package foragricultural Research Workers. Recent advances in information theory, statistics and computer application by DS Hooda and RC Hasija, Department of mathematicsstatistics, CCS HAU, Hisar.

Singh M.P., Lallu and N. B. Singh, 2014 : Thermal requirement of Indian mustard (*Brassica juncea*) at different phonological stages under late sown condition. *Ind. J. Plant Physiol.,***19**(3): 238-243.

Yadav, A. K., R. K. Arya , M. K. Singh, D. Kumar & R Panchta, 2016 : Heat tolerance in pearl millet : A review. *Forage Res.* **42**(2): 65-81.