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EVALUATION OF COWPEA VARIETIES UNDER DIFFERENT IRRIGATION SCHEDULES

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SUMMARY

A field experiment entitled "Evaluation of cowpea varieties under different irrigation schedules during summer season" was carried out during summer season, 2022 at the Research area of Forage Section Research Farm, Department of Genetics & Plant Breeding, Chaudhary Charan Singh Haryana Agricultural University. The experimental treatment consisted of combination of three irrigation schedules *viz*. at 7, 11 and 15 days interval and four cowpea varieties *viz*. RC 101, GC 1601, PGCP 24 and HC 46. The experiment was laid out in split plot with three replications on sandy loam soil having pH 7.9, EC 0.32 dS/m and organic carbon 0.46% with low available nitrogen (125 kg/ha), medium phosphorus (13.5 kg/ha) and medium potassium (290 kg/ha) status. Maximum no. of pods per plant (22.28), pod length (13.38), no. of seeds per pod (13.08), seed index (10.15) and seed yield (904 kg/ha) was recorded under irrigation at 11 days interval which was at par with irrigation at 15 days interval but superior over 7 days irrigation interval. Seed yield at irrigation schedule 11 days interval was 3.6 % and 36 % higher as compared to seed yield under 15 and 7 days interval. Significantly higher protein content in both seed and straw with respective values of 23.57 and 11.81% was reported under irrigation scheduling at 15 days interval. Among varieties, maximum no. of pods per plant (25.14) in GC 1601, pod length (15.34 cm), no. of seeds per pod (13.53), seed index (11.84g) in PGC 24 and seed yield (937 kg/ha) in GC1601 were recorded, respectively. Maximum protein content was recorded in variety GC 1601 (23.44 & 11.69%) which was at par with variety PGCP 24 (23.42 & 11.65%) and HC 46 (23.28 and 11.54%) with respective seed and straw protein content.

Key words: Cowpea, varieties, irrigation scheduling, seed yield and protein

Cowpea (*Vigna unguiculata* L. Walp) is a leguminous plant of Fabaceae family. It is an important grain legume crop in arid and semi-arid regions of the tropics and sub-tropics. The seeds of cowpea are good source of human protein, while the haulms are used as protein source for livestock (Belay *et al*., 2017). Cowpea is well known for its nutritional significance for human consumption as well as for livestock feed and an income generation source for poor farmers (Sheahan, 2012). It is a good source of carbohydrates (63%) and protein (25%), and has a high value of vitamin A and C, iron, phosphorus, calcium and amino acids like tryptophan and lysine with low fat content (1.5%) (Arul Prakasham *et al*., 2019).

It is cultivated in *kharif* and summer season as vegetable and grain pulse crop in India. According to food and agriculture organization (FAO) report in 2021 total estimated area and production of pulse in world was 80 million ha and 75.5 million tonnes, respectively. India is the largest producer and consumer of pulses, and account almost one third of world production (Anonymous, 2021). Total area, production and productivity of pulses in India in 2021-22 was 30.37m ha, 26.96 m ton and 888 kg ha^{-1}, respectively (Anonymous, 2022). Estimated area, production and productivity of cowpea dry seeds in world was 14.9 m ha, 8.99 m ton and 603 kg/ha, respectively. Cowpea grown over 0.5 m ha in India **(**Rajput and Rana, 2016). Though data related to area, production and productivity of cowpea is not accessible separately because it is integrated with beans in India. States like Rajasthan, Uttar Pradesh, Madhya Pradesh, Bihar, West Bengal, Punjab, and some areas of Himachal Pradesh are notable growers of cowpea. (Sharma, 2018).

It is typically adapts to biotic and abiotic stresses like drought, high temperatures, and other factors better than other crop plant species. However, due to the crop's growing demand, especially during the summer, it is vital to increase and speed up its production year-round. This suggests converting the currently practiced, traditional or subsistence

agriculture into modern agriculture by making extensive use of and managing modern irrigation facilities. (Faloye *et al*., 2016).

Soil moisture is an essential factor significantly affecting the yield of crops. It is difficult for roots to grow, penetrate, and develop when the soil is not sufficiently moist. The plants root is the part of plant responsible for absorption of water from the soil. Water management thus becomes the most crucial factor for the productivity of leguminous crops. Water management ensures the highest water use efficiency (WUE), which justifies the adoption of suitable irrigation techniques in helping to establish a favourable soil moisture environment for maximizing yield and enhancing crop health (Ghosh and Panja, 2016).

Mansouri and Shokoohfar (2015) reported that among irrigation intervals of 6, 11 and 16 in summer cowpea, 6 days interval has higher grain yield (1764.18 kg/ha). The irrigation interval of 6 days has increased the yield up to 26.81 and 40.93% as compared to 11 and 16 days interval irrigation, respectively. Bhowmik *et al*. (2020) obtained higher WUE of 10.75 kg/ha-mm with irrigation scheduling at CPE 60 than at CPE 40 that was recorded 4.09 kg/ha-mm. Other than irrigation, selection of a variety particularly under summer condition is also one of the most inevitable factors which affect the crop yield. Different varieties have different genetic makeup and phenotypic traits, which determine their yield potential, quality and resistance to biotic and abiotic stress. Hence, supplemental irrigation at critical growth stages during hot summer months and suitable varieties are very critical to realize the potential yield. Keeping the above facts in view, present study has been planned.

MATERIALS AND METHODS

The study was carried out at Research area of Forage Section Research Farm, Department of Genetics & Plant Breeding, Chaudhary Charan Singh Haryana Agricultural University, Hisar, during summer season 2022. In north western India, Hisar is located in the subtropics at longitude 75°46'E, latitude 29°10'N, and at an elevation of 215.2 m above mean sea level in Haryana. The weekly weather data recorded in Agro-Meteorology Observatory, CCS HAU, Hisar during the crop season are presented in Fig. 1. It indicates that the mean weekly maximum and minimum temperature ranged from 44 to 27.1°C and 28.6 to 10.5 °C, respectively, during the crop growing period. The weekly mean relative humidity ranged from 46 to 93% in morning hours and 17 to 50% in evening hours.

The experiment was laid out in Split plot design comprised of three irrigation schedules in main plot: I_1: Irrigation at 7 days interval, I_2: Irrigation at 11 days interval, I_3: Irrigation at 15 days interval and four varieties in sub plot: V_1: RC 101, V_2: GC 1601, V_3: PGCP 24, V_4: HC 46. The soil was sandy loam having pH 7.9, EC 0.32 dS/m and organic carbon 0.46% with low available nitrogen (125 kg/ha), medium phosphorus (13.5 kg/ha) and medium potassium (290 kg/ha) status. The crop was fertilized with 20 kg N and 40 kg P_2O_5 per ha through urea and DAP as basal dose. The sowing was done manually with the row spacing of 45 cm. Irrigations were applied as per the treatments (7, 11 & 15 day's interval). At crop maturity, five randomly chosen (already tagged) plants from each plot were initially harvested for recording necessary biometric observations, and the produce was subsequently added to the corresponding plot. Harvesting was done early in the morning and crop was left in each plot for 4 days of sun drying. The collected produce was simply weighed before threshing to record the biological yield after complete drying. After that, threshing of grains was done manually with the help of labour. Threshed seeds for each plot were then winnowed and weighed. The data were analyzed using appropriate analysis of variance (ANOVA). OPSTAT software was used to carry out statistical analysis.

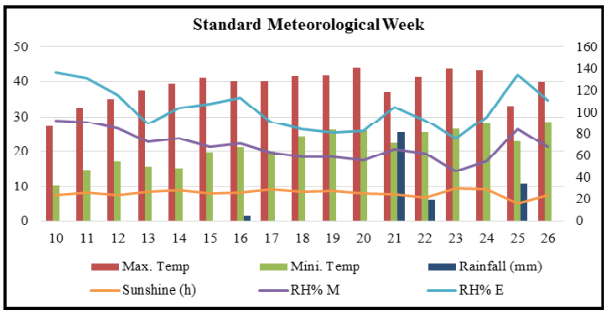

Fig. 1. Mean weekly meteorological data during the crop growing season 2022 recorded at experimental area, CCS HAU, Hisar.

RESULTS AND DISCUSSION

Yield attributes

No. of branches per plant was significantly affected by irrigation scheduling at different intervals at the harvest stage (Table 1). Data clearly shows that Irrigation scheduling at 7 days interval resulted in higher no. of branches per plant which was (6.22), followed by (6.01) irrigation at 11 days interval and lowest value (5.63) was observed with irrigation

TABLE 1
Effect of irrigation scheduling on yield and yield attributes of cowpea varieties

Treatments	No. of branches/ plant	No. of pods/ plant	Pod length (cm)	No. of seeds/ pod	Seed index (100 seed weight in g)
Irrigation schedules					
Irrigation at 7 days interval	6.22	15.00	12.23	11.33	9.30
Irrigation at 11 days interval	6.01	22.28	13.38	13.08	10.15
Irrigation at 15 days interval	5.63	20.93	13.33	12.76	10.00
S. Em±	0.07	0.41	0.16	0.18	0.12
C. D. (P=0.05)	0.28	1.64	0.63	0.74	0.47
Varieties					
RC 101	5.41	15.47	13.03	12.59	10.00
GC 1601	6.53	25.14	11.52	11.73	8.34
PGCP 24	5.87	19.71	15.34	13.53	11.84
HC 46	5.99	14.43	12.02	11.71	9.94
S. Em±	0.14	0.50	0.21	0.17	0.06
C. D. (P=0.05)	0.41	1.49	0.64	0.51	0.16

scheduling at 15 days interval. This might be due to optimal supply of soil moisture under irrigation at 7 days interval favorably improved the uptake and translocation of nutrients, which ultimately enhanced the vegetative growth of plant and thus increased the no. of branches per plant as compared to irrigation at 11 and 15 days interval where moisture availability was less. Maximum no. of pods per plant (22.28) was recorded with the irrigation scheduling at 11 days interval, followed by irrigation scheduling at 15 days interval (20.93) and minimum no. of pods per plant (15) was observed with irrigation scheduling at 7 days interval. It is evident from the data that highest value for pod length was observed with irrigation scheduling at 11 days interval that was 13.38 cm, which was at par with treatment irrigation scheduling at 15 days interval with pod length of 13.38 cm and the minimum pod length of 12.23 cm was observed in treatment irrigation scheduling at 7 days interval. Maximum no. of seeds per pod (13.08) were recorded with irrigation scheduling at 11 days interval, followed by irrigation scheduling at 15 days interval no. of seed per pod were 12.76. The minimum no. of seeds per pod (11.33) was observed with irrigation at 7 days interval. Highest value of seed index was observed with irrigation scheduling at 11 days interval which was at par with seed index under irrigation scheduling at 15 days interval with their respective values of 10.15 and 10. Possibly under irrigation at 7 days interval all the yield contributing parameters were reduced as compared to 11 and 15 days because surplus moisture favoured more vegetative growth and in leguminous crops there is inverse relation between reproductive and vegetative growth, excess of vegetative growth reduced the no. of flower buds per plant. With optimum plant growth and optimum moisture supply crop utilize most of photosynthates to reproductive attributes. But under irrigation scheduling at 7 days interval due to excessive moisture availability plant continue its vegetative growth and photosynthates were not utilized properly for yield contributing factors. The results were in accordance of Salim *et al.* (2018).

Significantly maximum no. of branches (6.53) were recorded under variety GC 1601, followed by HC 46 and PGCP 24 (5.99 and 5.87), respectively. The least no. of branches (5.41) was recorded in RC 101. In varieties the variation in no. of branches per plant was due to their inherent characters and interaction with environment. Varieties also differ significantly in no. of pods per plant at the time of harvesting. Among varieties, GC 1601 shows significantly higher no. of pods per plant (25.14) followed by PGCP 24 and RC 101 with values 19.71 and 15.47, respectively. Least no. of pods per plant (14.43) was recorded from HC 46. Maximum pod length of 15.34 cm was observed in variety PGCP 24, which performs significantly superior than the rest, followed by varieties RC 101 and HC 46 with values 13.03 cm and 12.02 cm, respectively. However, lowest pod length (11.52 cm) was recorded in variety GC 1601. Significantly higher no. of seeds per pod were observed in variety PGCP 24 with value of 13.53, followed by variety RC 101 and GC 1601 with values 12.59 and 11.73, respectively. The lowest no. of seeds per pod (11.71) was recorded in variety HC 46 which was at par with variety GC 1601. Varieties also differ significantly in seed index. Maximum value for seed index was observed in variety PGCP 24 with value 11.84, followed by RC 101 and HC 46 with respective value of 10 and 9.94. Among varieties this variation is due to different genetic makeup of varieties, their moisture and other resource utilization ability and their yield potential.

Seed yield

Table 2 presents the effect of irrigation scheduling on yield of cowpea varieties. It is evident from the table that cowpea varieties were significantly affected in terms of yield due to different irrigation schedules. Highest seed yield of 904 kg/ha was recorded when we apply irrigation at 11 days interval which was at par with yield of 873 kg/ha obtained in irrigation at 15 days interval. Significantly lowest yield of 660 kg/ha was obtained when we scheduled irrigation at 7 days interval. Possible reason to get lowest yield under 7 days interval irrigation scheduling was continues vegetative growth of crop for longer time due to excess availability of moisture but under irrigation schedules at 11 and 15 days interval plant have optimum growth for utilizing available resources toward seed formation through optimum photosynthesis. Corroborative results were also observed by Kumar *et al.* (2015).

TABLE 2
Effect of irrigation scheduling on yield and harvest index of cowpea varieties

Treatments	Seed yield (kg/ha)	Straw yield (kg/ha)	Biological Yield (kg/ha)	Harvest Index (%)
Irrigation schedules (I)				
Irrigation at 7 days interval	660	1935	2595	25.27
Irrigation at 11 days interval	904	1752	2656	34.30
Irrigation at 15 days interval	873	1711	2584	34.52
SE(m)±	14	40	45	0.6
CD (P=0.05)	57	161	NS	2.4
Varieties (V)				
RC 101	730	2047	2777	26.18
GC 1601	937	1862	2800	33.92
PGCP 24	900	1582	2483	36.79
HC-46	682	1706	2388	28.56
S. Em±	17	42	44	0.66
C. D. (P=0.05)	52	125	131	1.99

Significantly maximum straw yield of 1935 kg/ha was recorded when we scheduled the irrigation at 7 days interval, followed by irrigation scheduling at 11 and 15 days interval which were at par with each other with respective values of 1752 and 1711 kg/ha. Higher straw yield under irrigation at 7 days interval as compared to 11 and 15 days interval was because of excessive vegetative growth of plants due to frequent irrigation application which contributed in surplus soil moisture. The findings were confirmed by the results of Faloye *et al*. (2017). It can be clearly observed from the table that biological yield was not significantly affected under different irrigation schedules. In different irrigation schedules maximum harvest index was recorded when we apply irrigation at 15 days interval and was at par with 11 days interval of irrigation scheduling with respective values of 34.52% and 34.30%.

In varieties maximum seed yield of 937 kg/ha was obtained in variety GC 1601 which was at par with variety PGCP 24 with yield of 900 kg/ha, followed by 730 kg/ha yield in variety RC 101. Whereas the lowest yield of 682 kg/ha was obtained in variety HC 46 which was at par with variety RC 101. significantly highest straw yield of 2047 kg/ha was observed in variety RC 101 followed by variety GC 1601 and HC 46 with straw yield of 1862 kg/ha and 1706 kg/ha, respectively. However, lowest straw yield of 1582 kg/ha was recorded from variety PGCP 24 which was at par with variety HC 46. Straw yield of varieties was affected due to their growth habits and morphology, nutrient utilization ability. The results were in line with Kumar *et al*. (2015).

Highest biological yield was reported by variety GC101 which was at par with variety RC 101 with yield of 2800 and 2777 kg/ha, respectively, followed by biological yield of 2483 kg/ha in variety PGCP 24. Lowest yield of 2388 kg/ha was obtained by variety HC 46 which was at par with variety PGCP 24. Difference was due to morphology and growth pattern of varieties and their yield potential. The findings were in accordance with Belay *et al.* (2017). Significantly highest value of 36.79% was recorded in variety PGCP 24, followed by variety GC 1601 and HC 46 with respective harvest index of 33.92% and 28.56%. While significantly lowest value of 26.18% was observed in variety RC 101.

Quality

Data in Table 3 revealed that significantly higher protein content in both seed and straw with respective values of 23.57 and 11.81% was reported under irrigation scheduling at 15 days interval, followed by irrigation scheduling at 11 days interval with corresponding protein content of 23.29 and 11.58 % in seed and straw. Lowest protein content of 23.15 and 11.34% was recorded with irrigation at 7 days interval which was at par with irrigation at 11 days interval in terms of protein content in straw. Among varieties, maximum protein content was recorded in variety GC 1601 (23.44 & 11.69%) which was at par with variety PGCP 24 (23.42 & 11.65%) and HC 46 (23.28 and 11.54%) with respective seed and straw protein content. Minimum protein content was observed in variety RC 101 (23.21 & 11.42%) in seed and straw, respectively which was at par with variety HC 46. Variation in the protein content in different irrigation schedules and varieties was due to difference

TABLE 3
Effect of irrigation scheduling on protein content (%) in seed and straw of cowpea varieties

Treatments	Protein content in seed (%)	Protein content in straw (%)
Irrigation schedules		
Irrigation at 7 days interval	23.15	11.34
Irrigation at 11 days interval	23.29	11.58
Irrigation at 15 days interval	23.57	11.81
S. Em±	0.02	0.07
C. D. (P=0.05)	0.06	0.27
Varieties		
RC 101	23.21	11.42
GC 1601	23.44	11.69
PGCP 24	23.42	11.65
HC 46	23.28	11.54
S. Em±	0.02	0.07
C. D. (P=0.05)	0.06	0.20

in N content because N is the key element in protein structure. Similar results were reported by Singh *et al*. (2014).

CONCLUSION

Based on the results of the study, it may be concluded that summer cowpea responded well to irrigation schedules from 15 to 7 days interval, but 11 days interval was found most optimum in terms of seed yield as compared to 7 days interval where the harvest index was lowest, but at par with 15 days interval. Among varieties, GC1601 performed better in terms of seed yield and protein content followed by PGCP 24.

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REFERENCES

Anonymous, 2021: FAO report (2021). "FAOSTAT: Crops." http://www.fao.org/faostat/en/#data/QC.

Anonymous, 2022: Second advance estimates of production of Pulse crop for 2021-22. Directorate of Economics and Statistics, Ministry of Agriculture and Farmers Welfare. *https://eands.dacnet.nic.in/Advance_Estimate/Time%20Series%202%20AE%20202122%2(English). Pdf.*

Arul Prakasham, S.M., S.P. Ramanathan, K. Annadurai, and B. Jeberlin Prabina, 2019: Influence of irrigation regimes and organics on the productivity and quality of vegetable cowpea (*Vigna unguiculata* (L) Walp). *Journal of Pharmacognosy and Phytochemistry*, **8**(3): 3391-3393.

Belay, F., A. Gebreslasie and H. Meresa, 2017: Agronomic performance evaluation of cowpea [*Vigna unguiculata* (L.) Walp.] varieties in Abergelle District, Northern Ethiopia. *Journal of Plant Breeding and Crop Science*, **9**(8): 139-143.

Bhowmik, A., S. Khawas, G. Dutta, R. Ray and S.K. Patra, 2020: Response of summer cowpea to growth, yield and water use efficiency under different irrigation and nutrient management in lower Indo-gangetic plains. *International Journal of Current Microbiology and Applied Sciences*, **9**: 900-911.

Faloye, O.T. and M.O. Alatise 2017: Response of soil moisture content, evapotranspiration and yield of cowpea to varying water application. *Agricultural Engineering International: CIGR Journal*, **19**(4): 66-75.

Faloye, O.T., A.S. Ojo, and O. Fasanu, 2016: Effect of irrigation on growth of cowpea at different developmental stages and water use efficiency. *Swift Journal of Agricultural Research*, **2**(1): 001-011.

Ghosh, U. and P. Panja 2016: Legumes under different irrigation system- A Review. *Advances in Life Sciences*, **5**(18): 7263-7268.

Kumar, M., J.J. Patel, A. Umale, R.D. Prasad and H.K. Patel, 2015: Performance of cultivar and irrigation scheduling (IW/CPE ratio) on yield, water use efficiency, consumptive use of water and economics of summer cluster bean (*Cymopsis tetragonoloba* L.) under middle Gujarat condition. *Research in Environment and Life Sciences*, **8**(4): 599-602.

Mansouri, S. and A. Shokoohfar, 2015: Effect of potassium fertilizer and irrigation intervals levels on yield and yield components of cowpea (*Vigna unguiculata*) in ahvaz condition. *Indian Journal of Fundamental and Applied Life Sciences*, **5**(1): 26-32.

Rajput, S.K. and D.S. Rana, 2016: Crop diversification with vegetable cowpea. *Indian Farming*, **66**(1): 5-9.

Salim, S. A., I. K. Hamza and Jar, F. Laith, 2018: Irrigation scheduling and water requirement for cowpea using evaporation pan at middle of Iraq. *Journal of Aridland Agriculture*, **4**: 13-17

Sharma, A., 2018: Influence of Drip Irrigation Regimes on Growth, Yield and Quality in Different Variety of Cowpea (*Vigna unguiculata* (L.) Walp). M.Sc. (Ag.) Thesis, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior College of Horticulture, Mandsaur (M.P.), India.

Sheahan, C.M., 2012: Plant guide for cowpea (*Vigna unguiculata* (L.) Walp). *USDA Natural Resources Conservation Services,* Cape May, Plant Materials Center, Cape May, NJ.

Singh, A.K., A.K. Singh, A. Jaiswal, A. Singh, P.K. Upadhyay and S.K. Choudhary, 2014: Effect of irrigations and phosphorus fertilization on productivity, water use efficiency, and soil health of summer mungbean (*Vigna radiata* L.). *The Ecoscan*, **8**(1&2): 185-191.