E-ISSN: 2618-0618
P-ISSN: 2618-060X

www.agronomyjournals.com
2024; 7(1): 59-61
Received: 25-10-2023
Accepted: 08-12-2023

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Evaluation of cowpea (*Vigna unguiculata* (L.) Walp) genotypes under water stress condition in Konkan region

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DOI: https://doi.org/10.33545/2618060X.2024.v7.i1a.191

Abstract
The field experiment was conducted during *rabi* season 2022 at Research and Education farm, Department of Agricultural Botany, College of Agriculture, Dapoli to evaluate the cowpea *(Vigna unguiculata* (L.) Walp) genotypes under water stress condition in Konkan region. The field experiment was laid out in strip plot design comprising five different water stress treatments with four genotypes replicated thrice. The result revealed that, the yield attributing characters of cowpea is highest in treatment T_1 as compared other water stress treatment and when we consider about four different varieties, the variety V_3 recorded highest yield attributing characters such as No. of pods per plant, No. of seeds per plant, 100 seed weight and harvest index.

Keywords: Treatment, variety, cowpea, water stress, yield

Introduction
Cowpea (*Vigna unguiculata* (L.) Walp) is most important legume crop in Asia, Africa, Australia and grown throughout the region of semiarid tropics of Asia, Africa, Southern Europe (Timko *et al.*, 2007) [17]. The origin of cowpea is west and central region of Africa. The other names of cowpea are *chawali*, Southern Pea, etc. belonging to family *leguminaceae* (Mackie and Smith, 1935) [10].

Cowpea is used for fodder purpose makes an important contribution to feed supplies for animals to maintain their health in dry season. (Quin, 1997) [14] It is also called as Poor man's meat. The green tender pod has 84.9% moisture, 4.3% protein, 8.0% carbohydrates, 2% fats (Aykroyd, 1963) [3]. Cowpea seeds contain on an average 21.0-26.7% of protein (Weng *et. al.* 2017) [18] and 2.2% lipid (Frota *et al.* 2008) [5].

Cowpea is grown in different types of climatic conditions. It is an annual crop that is adapted to warm conditions and sensitive to chilling. It is 750 to 1100 mm rainfall ranges, grow well in low rainfall and diseases and pests attack increase due to high rainfall. The temperature requirement of cowpea lies between 21-35 °C. Through the symbiotic bacteria, cowpea fixes atmospheric nitrogen to the extent of 563 kg ha^{-1}.

In the konkan region, the common pulses such as pigeon pea, horse gram, wal, cowpea and moth bean are sown during late *kharif* or immediately after the end of monsoon. Water stress is one of the major abiotic factors limiting plant growth and crop productivity in South Africa, Semi and Arid countries (Kramer, 1983) [8]. Due to water stress, yield of cowpea is reduced. Other reports stated that the cowpea is sensitive to water deficit during the flowering stage and pod filling stages (Akyeampong 1986) [2]. Water deficit is known as one of the major factors decreasing crop yield in different region.

Generally, water stress occurred to the *rabi*, cowpea shows the reduction in grain yield at the range of 24-89% under mild to severe stress (Patil 1989) [13]. In cowpea, water stress basically affects the plant growth and development and recognized as one of the most important factors influencing crop yield (Kramer and Boyer 1995) [9].

Materials and Methods

The present study was carried out at Research and Education farm, Department of Agricultural Botany, College of Agriculture, Dr. B.S.K.K.V. Dapoli (MH) during rabi season of 2022. The field experiment was laid out in five treatments with four genotypes. Cultivation of these genotypes was grown in strip plot design with three replications. The water stress treatments were imposed at five different levels. In first water stress treatment (T_1), crop was grown on absolute control condition means the regular irrigation from sowing to maturity. In second water stress treatment (T_2), cowpea crop was grown on available soil moisture stress from sowing to harvesting. In third water stress treatment, irrigation was done at only branching stage. In fourth water stress treatment (T_4), irrigation was done only at flowering stage. In fifth water stress treatment (T_5), irrigation was done only at pod filling stage. The experiment comprised of four varieties of cowpea such as Konkan Safed (V_1), Konkan Sadabahar (V_2), Phule Sonali (V_3), Phule Rukmini (V_4).

Results and Discussion

The results pertaining in the present study is presented in table 3. Plant yield is based on total assimilation during the growing season and how it is distributed between the designated storage structures and the rest of the plant. Yield is a compound character made up of the sum of the contributions produced by various physiological traits. It is the net economic gain from the source and sink capacity, as per point of view of plant physiologist. The present investigation of yield attributing characters was presented under the following heads.

Number of pods per plant

It is important factor that is directly affects the number of pods produced per plant is the pod yield per plant. The increase plant height and number of branches per plant may be the cause of the increase in the number of pods produced per plant. There were significant differences in the number of pods per plant recorded at harvest for all treatments. Maximum number of pods was recorded in treatment T_1 (7.35) which was followed by treatment T_4 (5.35) and treatment T_5 (4.36) over rest of the all treatments. However, minimum number of pods per plant was observed in treatment T_2 (2.71), under water stress condition. Among four varieties in treatment T_1, Variety V_3 (8.40) was noted consequently highest number of pods per plant all over other varieties followed by variety V_2 (7.60). However, in treatment T_2, variety V_4 (2.26) noted the minimum number of pods per plant. Similar results were reported by Parab (1991) [12] in cowpea, Shinde (1998) [16] in five legumes crop, Abidoye (2004) [1] in cowpea, Futuless and Bake (2009) [19] in cowpea, Kardile (2011) [7] in cowpea, Menon and Savitri (2015) [11] in cowpea, Ricardo Santas *et al.*, (2020) [15] in cowpea crop.

Number of seeds per plant

Number of seed per plant is desired character which has direct effect over number of pods per plant. It was noted that there is a significantly different in number of seeds per plant among all treatments under water stress. Maximum number of seeds per plant was noted in treatment T_1 (48.00) which was followed by treatment T_4 (36.68) and treatment T_5 (28.75) over rest of the all treatments. However, minimum number of seeds per plant was observed in treatment T_2 (15.73), under water stress condition. Among four varieties in treatment T_1, Variety V_3 (68.60) was noted consequently highest number of seeds per plant all over other varieties followed by variety V_2 (46.13). However, in treatment T_2, variety V_4 (12.67) noted the minimum number of seeds per plant. Similar results were recorded by Parab (1991) [12] in cowpea, Shinde (1998) [16] in five legumes crop, Abidoye (2004) [1] in cowpea, Kardile (2011) [7] in cowpea, Menon and Savitri (2015) [11] in cowpea, Ricardo Santas *et al.*, (2020) [15] in cowpea.

Table 1: Influence of different water stress treatments on yield attributing characters at various stages of plant growth of cowpea grown under water stress condition

Genotypes	Treatments of water stress						SE ±	CD at 5%
	T_1	T_2	T_3	T_4	T_5	Mean		
No. of pods per plant								
V_1	7.00	2.40	3.40	5.00	4.00	4.36	V. 0.0133	0.0461
V_2	7.60	2.80	3.80	5.60	4.60	4.88	T. 0.0091	0.0298
V_3	8.40	3.40	4.40	6.40	5.40	5.60	T x V 0.0183	0.0533
V_4	6.40	2.26	3.20	4.40	3.46	3.94		
Mean	7.35	2.71	3.70	5.35	4.36	4.69		
No. of seeds per plant								
V_1	38.93	14.40	25.47	30.53	27.87	27.44	V. 0.2634	0.9115
V_2	46.13	15.93	26.47	42.67	27.93	31.83	T. 0.3247	1.0590
V_3	68.60	19.93	34.73	43.93	35.73	40.59	T x V 0.6129	1.7890
V_4	38.33	12.67	22.87	29.60	23.47	25.39		
Mean	48.00	15.73	27.38	36.68	28.75	31.31		
100 seed weight (g)								
V_1	12.14	8.37	9.28	11.41	10.55	10.35	V. 0.1071	0.3706
V_2	10.97	6.64	7.54	8.67	8.21	8.37	T. 0.1619	0.5279
V_3	12.76	10.36	11.20	11.69	11.39	11.48	T x V 0.1935	0.5647
V_4	11.09	8.09	8.19	9.56	8.93	9.17		
Mean	11.70	8.36	9.05	10.33	9.77	9.84		
Harvest index (%)								
V_1	12.44	8.40	8.49	10.86	11.27	10.29	V. 0.2291	0.7927
V_2	10.72	6.50	7.22	9.96	8.65	8.16	T. 0.2932	0.9562
V_3	18.56	9.87	17.20	17.02	14.42	15.41	T x V 0.7413	2.1637
V_4	8.80	6.02	7.49	8.41	6.60	7.46		
Mean	12.63	7.69	10.10	11.56	10.23	10.47		

V. - Variety T. - Treatment T. x V. - Treatment x Variety

100 seed weight (g)

100 seed weight is another important factor which indicates yield of the crop. In current study, variation in 100 seed weight was observed among all water stress treatments. In present study, under water stress condition significantly maximum 100 seed weight was found in treatment T_1 (11.70 g) which was followed by treatment T_4 (10.33 g) and treatment T_5 (9.77 g) over rest of the all treatments. However, minimum 100 seed weight was observed in treatment T_2 (8.36 g). Among four varieties in treatment T_1, Variety V_3 (12.76 g) was noted consequently highest 100 seed weight all over other varieties followed by variety V_1 (12.14 g). However, in treatment T_2, variety V_2 (6.64 g) noted the minimum 100 seed weight. Similar results were recorded by Parab (1991) [12] in cowpea, Shinde (1998) [16] in five legumes crops, Abidoye (2004) [1] in cowpea, Kardile (2011) [7] in cowpea, Menon and Savitri (2015) [11] in cowpea, in lablab, Ricardo Santas *et al.,* (2020) [15] in cowpea.

Harvest index (%)

Although, the importance of both seed and biomass production, seed yield is more important than biomass production; as a result, the relationship between seed and biomass has to be studied. Harvest index means the percentage of biological yield represented by economic yield. Donald (1962) [4] gives the term of harvest index as the ratio of grain weight to the total dry weight of above ground parts at harvest of the crop. Since each crop's yield is influenced by its capacity to produce dry matter partitioning of economic and non-economic parts, is interest to plant researchers, because the yield of any crop was depend on the its capacity to produce dry matter production and its efficient partitioning between the economic and noneconomic parts.

In present study, highest mean harvest index was observed in treatment T_1 (12.63%), followed by treatment T_4 (11.56%) while lowest harvest index was observed in treatment T_2 (7.69%). Among four varieties in treatment T_1, variety V_3 (18.56%) was noted consequently highest harvest index all over other varieties followed by variety V_3 (17.20%) in treatment T_3. However, in treatment T_2, variety V_4 (6.02%) noted the minimum harvest index. Similar results were recorded by Parab (1991) [12] in cowpea, Shinde (1998) [16] in five legumes crops, Abidoye (2004) [1] in cowpea, Kardile (2011) [7] in cowpea, Menon and Savitri (2015) [11] in cowpea, Ricardo Santas *et al.,* (2020) [15] in cowpea.

Conclusion

Among all treatments, T_1 was found to be significantly superior followed by treatment T_4 reported better performance in context with highest yield attributing components like number of pods, number of seeds per plant, 100 seed weight and harvest index when compared with rest of the treatments.

Thus, the current study revealed that, the use of irrigation at their vegetative and critical growth stages of plant growth like irrigation at branching stage, irrigation at flowering stage, irrigation at pod filling stage was enhanced the yield of cowpea grown under water stress condition. Among all treatments, variety V_3 followed by variety V_2 enhanced the yield of cowpea grown under water stress condition.

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