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Effect of irrigation regimes on quality parameters of Cowpea (*Vigna unguiculata* L. Walp.)

Kumari Lata, PK Yadav, RS Rathore and NK Pareek

Abstract
Cowpea is a good protein source for the persons who lived in a semi-arid land of world. In case of healthy and safe food, cowpea (*Vigna unguiculata* L. Walp) are a significant source of protein, carbohydrate and minerals especially for poor population of world. It is commonly known as vegetable meat due to high protein content in it's seeds, in some areas of world it is also known as poor man's meat. The aim of this study was to determine the nutritional value of crop among the irrigation level applied and suitable cowpea variety for cultivation in arid western region of Rajasthan among varieties Kashi Nidhi, Kashi Kanchan, Pusa Sukomal and Swarna Mukut. The experiment was arranged in Split Plot Design. Cowpea compositions were ranged for chlorophyll (2.01-2.71 mg g^{-1}), protein (7.51-9.71%) and crude fiber (3.66-4.81%). Vegetable cowpea samples recorded highest amount of chlorophyll, protein and crude fiber with 100% PE irrigation levels and variety Kashi Nidhi and highest no. of seeds reported with 80% PE irrigation level which was at par with 100% PE irrigation level and variety Kashi Nidhi at par with Swarna Mukut.

Keywords: Cowpea, irrigation regimes, varieties, quality parameters

Introduction
Cowpea [*Vigna unguiculata* L. Walp] commonly known as *lobia* is one of the important *kharif* legume crop grown for pod, grain, forage and green manuring. The crop has heavy vegetative growth which covers the ground fully and checks the soil erosion in problem areas. It can be later ploughed down for green manuring. It contains about 24.6% protein in seeds and it is grown as pulses and vegetable both crops (Arul, *et al*., 2019) [5]. It has considerable purposes as an alternative vegetable crop in dry land farming (Choudhary and Yadav, 2011) [6]. It is also known as *chavla* in Rajasthan and used as food at both the green and dry stage of pods and seeds simultaneously. Cowpea seeds are a very good nutritious food for human as well as cattle feed. It contains 8 g carbohydrates, 0.6 g fat and 2 g fiber per 100 g of edible portion. The protein content ranges about 3-5% in green leaves, 4-5% in immature pods and 25-30% in mature seeds. Because of higher protein content in mature seeds of cowpea, it is commonly called as vegetable meat (Gopalakrishnan, 2007) [9].

It is a deep rooted crop and perform well in sandy soil therefore, it is better adapted to dry, high temperatures and biotic stresses areas than the other crop plant species. It is grown in arid and semi-arid regions of the world where it is considered as the most drought tolerant legume. It is cultivated in Rajasthan, Uttar Pradesh, Madhya Pradesh, Karnataka, Jharkhand, Bihar, West Bengal, Punjab and Himachal Pradesh in significant manner. The area of cultivation of vegetables in India for the year 2020-21 is 10.86 million hectare with production of 200.44 million tonne and the area under vegetables in Rajasthan is 189.39 thousand ha with production of 2185.86 thousand MT. The area and production of beans in India is 0.261 million hectare and 2.595 million tonne production (Anonymous 2020-21) [3].

Materials and Methods
A field experiment was conducted during *kharif* season of 2019 and 2020 at the Research Farm, College of Agriculture, SKRAU, Bikaner in a split plot design with three replications. The soil was loamy sand in texture, alkaline in reaction (pH 8.5), low in organic carbon (0.12%), available nitrogen (117 kg/ha), available phosphorus (15.4 kg P2O5/ha) and medium in potassium (172.7 kg K2O/ha) content. The experiment consisted of four treatments of irrigation (40% PE, 60% PE, 80% PE and 100% PE) with four varieties (Kashi Nidhi, Kashi Kanchan, Pusa Sukomal and Swarna Mukut) of vegetable cowpea.

After seed sowing up to 10 days regular irrigation were applied for better germination of plants. The basal dose of fertilizers were applied at the time of field preparation in ratio of 30:60:60 of N_2O, P_2O_5 and K_2O (50% nitrogen is applied as a basal dose). Irrigation was scheduled based on climatological approach. The experiment was laid out in split plot design with irrigation as main plot treatment and varieties as sup plot treatment and replicated thrice.

Total chlorophyll content in leaves was determined at 50 days after sowing by using the method of Hiscox and Israelstom (1979) [12] with slight modification. 50 mg fresh leaf material from randomly selected leaf was used for chlorophyll estimation. The material was taken in test tube to which 5.0 ml DMSO was added. These tubes were tightly capped and placed in an oven at 60 °C for 6 hrs. Finally the tubes were thoroughly shaken and extracted solvent was decantated to read at 645 and 663 nm by spectrophotometer. The amount of total chlorophyll in leaves (mg/g) was calculated as advocated by Arnon (1949) [4].

$$\text{Total chlorophyll in leaves (mg g}^{-1)} = \frac{A_{(652)} \times 29 \times \text{Total Volume (ml)}}{\alpha \times 1000 \times \text{Weight of sample (g)}}$$

Where, A = Absorbance specific wave length, α is the path length = 1 cm

The amount of protein in cowpea pods was calculated in mg/100g. The formula used for calculating the protein is as under:

Protein (mg/100g) = Nitrogen × 6.25*

*This is based on the assumption that plant protein contains 16% nitrogen.

Crude fibre content in whole plant was estimated by acid-alkali digestion method and was expressed in percentage (A.O.A.C., 1990) [1].

$$\text{Crude fibre (per cent)} = \frac{\text{Weight of residue} - \text{weight ash}}{\text{Weight of sample taken}} \times 100$$

Result and Discussion

Effect of irrigation regimes: The chlorophyll content in leaves at 60 days after sowing, crude fiber content in green pods and protein content in green pods are presented in table 1. The data indicates that the chlorophyll content in leaves after 60 days of sowing were recorded significantly higher with 100% PE irrigation level (2.61, 2.71 and 2.66 mg g^{-1}) that was statistically at par with 80% PE irrigation level (2.58, 2.68 and 2.63 mg g^{-1}) over the irrigation at 60% and 40% PE for the year 2019, 2020 and pooled mean basis. The increase in chlorophyll content with 80% PE in tune of 7.35 and 30.85 over the irrigation level 60% and 40% PE as per the pooled mean basis, respectively. Warren and Bilderback (2004) [17] observed the similar results.

Significantly maximum protein content (9.58, 9.60 and 9.59%) was recorded under 80% PE irrigation level as compared to 60% and 40% PE, but at par with 100% PE (9.67, 9.71 and 9.69%) during 2019, 2020 and pooled results, respectively. The minimum protein content was recorded with 40% irrigation level with findings 7.51, 7.56 and 7.54% during the year 2019, 2020 and pooled basis. The protein content recorded with 80% PE level of irrigation increased to the tune of 9.98 and 21.19% over 60% and 40% PE, respectively on pooled mean basis. Kanda *et al*., 2020 [13] had notices the same in reference of protein content.

Results revealed that crude fiber content of cowpea pods at irrigation level 80% PE was found maximum (4.69, 4.77 and 4.73%) which was significantly higher over irrigation level 60% and 40% PE and statistically at par with 100% PE (4.74, 4.81 and 4.78%). The amount of crude fiber content was recorded minimum with 40% PE irrigation level with values 3.66, 3.81 and 3.73% during the year 2019 and 2020 as well as pooled mean basis. Further, data showed that 80% PE shown increase over 60% and 40% PE in tune of 10.00 and 26.81 on the basis of pooled results. The similar findings were recorded by Gupta *et al*. (2017) [10] and Deewan *et al*. (2017) [7].

Response of varieties

The experimental data presented in table.1indicated that varieties had significant effect over chlorophyll content in leaves at 60 days after sowing and crude fiber content in pods while protein content were found non-significant for the year 2019, 2020 and pooled mean basis, respectively.

Table 1: Effect of irrigation regimes on chlorophyll content in leaves, protein content in green pods and crude fiber content in green pods of cowpea varieties

Treatments	Chlorophyll (mg per g)			Protein Content (%)			Crude fiber (%)		
	2019	2020	Pooled	2019	2020	Pooled	2019	2020	Pooled
Irrigation levels									
40% of PE	2.01	2.02	2.01	7.51	7.56	7.54	3.66	3.81	3.73
60% of PE	2.42	2.48	2.45	8.69	8.75	8.72	4.24	4.36	4.30
80% of PE	2.58	2.68	2.63	9.58	9.60	9.59	4.69	4.77	4.73
100% of PE	2.61	2.71	2.66	9.67	9.71	9.69	4.74	4.81	4.78
S.Em.±	0.04	0.04	0.03	0.17	0.17	0.12	0.08	0.08	0.06
CD at 5%	0.15	0.16	0.10	0.59	0.58	0.37	0.26	0.28	0.17
Varieties									
Kashi Nidhi	2.50	2.55	2.52	9.02	9.08	9.05	4.55	4.66	4.61
Kashi Kanchan	2.44	2.51	2.47	8.91	8.97	8.94	4.42	4.56	4.49
Pusa Sukomal	2.30	2.36	2.33	8.70	8.74	8.72	4.13	4.18	4.16
Swarna Mukut	2.38	2.47	2.43	8.82	8.83	8.82	4.22	4.35	4.29
S.Em.±	0.04	0.05	0.03	0.15	0.14	0.10	0.06	0.06	0.05
CD at 5%	0.13	0.13	0.09	NS	NS	NS	0.19	0.19	0.13

The data indicates that the variety Kashi Nidhi was reported statistically at par with Kashi Kanchan and recorded significantly higher for chlorophyll content in leaves at 60 DAS as compared to Swarna Mukut and Pusa Sukomal in 2019, 2020 and pooled basis, respectively. The lowest chlorophyll content was recorded under Pusa Sukomal (2.30, 2.36 and 2.33 mg g-1) which was closely followed by Swarna Mukut (2.38, 2.47 and 2.43 mg g-1) during both the years as well as pooled basis. The % increase in chlorophyll content with variety Kashi Nidhi was recorded in tune of 3.70 and 8.15% over the varieties Swarna Mukut and Pusa Sukomal as per pooled data. The similar findings were recorded by Hayatu and Mukhtar (2010) [11], Mwale *et al.* (2017) [14] and Saleh (2018) [15].

Highest protein content (9.02, 9.08 and 9.05%) was found with variety Kashi Nidhi closely followed by Kashi Kanchan (8.91, 8.97 and 8.94%), Swarna Mukut (8.82, 8.83 and 8.82%) and Pusa Sukomal (8.70, 8.74 and 8.72%), respectively during the year 2019, 2020 and pooled mean basis. The variety Kashi Nidhi was found superior in respect crude fiber content of pods over the varieties, Swarna Mukut and Pusa Sukomal but remains statistically at par with Kashi Kanchan during the year 2019, 2020 and pooled mean basis. Highest crude fiber content was found with Kashi Nidhi (4.61%) which was at par with Kashi Kanchan (4.49%) on pooled mean basis. The percentage increase with Kashi Nidhi in tune of 7.46 and 8.41% over Swarna Mukut and Pusa Sukomal, respectively on pooled mean basis. The similar findings were observed by Alghamdi (2009) [2], Sallam and Ibrahim (2016) [16] and Gerrano *et al*. (2022) [8].

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