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Effect of different Natural Farming Practices on NPK and Chlorophyll Content of Cowpea (*Vigna unguiculata* L.) under Sub humid Southern plains of Rajasthan

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ABSTRACT: With growing environmental concerns and demand for safe healthy food, the sole dependence on chemical input-based agriculture is being replaced by organic and natural farming practices. A field experiment was conducted in 2020 and 2021 at the Organic Farming Unit (Agronomy), Rajasthan College of Agriculture, MPUAT, Udaipur. The soil at the test location was clay loam in texture, with accessible nitrogen, phosphorus, and potassium concentrations of 255.30, 25.83 and 305.41 kg ha^{-1}, respectively in the top 30 cm of soil with a pH of 7.9. The experiment comprised 27 treatment combinations assigned in a randomised block design with three replications. The experiment comprised of 9 treatments of different practices *viz.*, treatment T_1-(Control), treatment T_2-(Complete NF *i.e*. 1. Beejamrit + Ghanjeevamrit + Jeevamrit; 2. Crop residue mulching; 3. Intercropping; 4. Whapasa), treatment T_3-NF without 1 (Beejamrit + Ghanjeevamrit + Jeevamrit), treatment T_4-NF without 2 (Crop residue mulching), treatment T_5-NF without 3 (Intercropping), treatment T_6-NF without 4 (Whapasa), treatment T_7-(AI-NPOF package), treatment T_8-[Integrated Crop Management (50 % nutrient application through organic manures and 50% nutrient application through inorganic sources with the use of Neemaster, Agniaster for pest management) and treatment T_9-[Integrated Crop Management (50 % nutrient application through organic manures and 50% nutrient application through inorganic sources with an application of need-based pesticides for pest management)].

Results of two-year experimentation revealed that maximum chlorophyll content at 30 and 45 DAS and NPK content in seed and haulm in cowpea was observed with T_9 [Integrated Crop Management (50 % nutrient application through organic manures and 50% nutrient application through inorganic sources with the application of need-based pesticides for pest management)] which was significantly higher than the rest of the treatments, However, the effect of T_9 treatment was statistically equivalent to treatment T_8 [Integrated Crop Management (50 % nutrient application through organic manures and 50% nutrient application through inorganic sources with use of Neemaster, Agniaster, Brahmaster and Dashparni ark for pest management)] and treatment T_7 (AI-NPOF package).

Keywords: Cowpea, chlorophyll content, natural farming, Integrated, content.

INTRODUCTION

The country realized admirable position in food production (308.60 million tonnes), unfortunately, farming itself turned non-profitable overtime due to intensifying production costs, reduced soil fertility due to excessive use of chemical fertilizers and pesticides at the cost of minimal use of organic fertilizers manure. The agrochemicals enhanced crop productivity during 1970-90's. From late 1990's, both crop production and productivity are showing signs of plateau. Total factor productivity is declining. Intensive use of inorganic chemical fertilizers and pesticides resulted in contamination of soil, surface and ground water with harmful chemicals. There are grave signs of health risks due to use of these agro-chemicals in general and of synthetic pesticides in particular. Environmental pollution by chemical fertilizers and pesticides is posing a serious threat worldwide. Presently, the cost of cultivation has been rising which is reducing the farm profits, increasing the net income and reducing the costs stabilize the farmers' income. To overcome the ill effects of green revolution on soil quality and income of farmers by ensuring their income security, is the foremost concern to all scientists, policymakers and cultivators. In this circumstance, organic natural farming is being practiced and adopted by farmers in India as a sustainable method of farming. Farmers need improved practices for cultivation of crops with organic standards as national programme on organic production. At national and state level, package of practices for organic farming has been developed (Ravishanker *et al*., 2017 and Sharma *et al.*, 2017).

Among pulses, cowpea (*Vigna unguiculata* L.) is a valuable *Kharif* pulse crop. It is used as a grain crop, animal fodder or vegetable. It's green pods are known by various names such as 'Snake bean', 'Asparagus bean', 'Yard long bean" Black-eyed pea', 'Crowder pea' and 'Southern pea'. The mature cowpea seeds have about 25% protein content, 63.6%, carbohydrate, 1.9% fat, 3% fibre, 0.00074% thiamine, 0.00042% riboflavin and 0.0028% niacin (Davis *et al*. 2000). In Indian agriculture, it is widely cultivated for its high nutritive value and health enhancing attributes (Sombie *et al.*, 2018). It is grown as a major pulse mainly in Kerala, Punjab, West Bengal, Tamil Nadu, Andhra Pradesh, and Gujarat. In Rajasthan, cowpea is grown on 0.78 lakh hectares area with an annual production of 0.26 lakh tonnes and average productivity of 337 kg ha^{-1} (Government of Rajasthan, Jaipur 2022).

MATERIAL AND METHODS

The field investigation was carried out during *Kharif* 2020 and 2021 at the Organic Farming Unit, Department of Agronomy, Rajasthan College of Agriculture, MPUAT, Udaipur, Rajasthan, India. It is situated in the agro-climatic zone IV-a (Sub-humid Southern Plains and Arrivals Hills) of Rajasthan, in the South Eastern region of the state, at an elevation of 581.16 metres above mean sea level and 24º35' N latitude and 72º42' E longitude. This area experiences typical subtropical weather, with milder winters and moderate summers accompanied by high relative humidity from June to September.

The South West monsoon, which occurs from June to September, is primarily responsible for the majority of the 542 mm of yearly rainfall that falls over both seasons of the crop period. The soil at the test location was clay loam in texture, with accessible nitrogen, phosphorus, and potassium concentrations of 258.30, 28.83, and 323.41 kg ha^{-1}, respectively in the top 30 cm of soil with pH 7.9. The research trial comprising 24 treatment combinations and laid out in randomized block design with three replications.

The experiment comprised 9 treatments of different practices viz., treatment T_1 (Control), treatment T_2- Complete NF (1. Beejamrit + Ghanjeevamrit + Jeevamrit; 2. Crop residue mulching; 3. Intercropping; 4. Whapasa), treatment T_3- NF without 1 (Beejamrit + Ghanjeevamrit + Jeevamrit), treatment T_4- NF without 2 (Crop residue mulching), treatment T_5- NF without 3 (Intercropping), treatment T_6- NF without 4 (Whapasa), treatment T_7- AI-NPOF package, treatment T_8- [Integrated Crop Management (50 % nutrient application through organic manures and 50% nutrient application through inorganic sources with the use of Neemaster, Agniaster for pest management) and treatment T_9- **[**Integrated Crop Management (50 % nutrient application through organic manures and 50% nutrient application through inorganic sources with the application of need-based pesticides for pest management)]. The observations recorded on growth were subjected to analysis of variance with a mean comparison of a 5 percent level of significance. Fresh leaf sample were collected from randomly selected healthy plants at 30 DAS and 45 DAS. These were carried to the lab right away, rinsed with distil water, and dried with blotting paper. A 100 mg sample was taken from each experimental treatment in motor and pastel. The sample was crushed well with 80-85% acetone and filtered into a 25 ml volumetric flask. The volume was increased and the absorbance was measured. The chlorophyll content was calculated as per standard procedure of protocol (Arnon, 1949).

$$\text{Total chlorophyll (mg g}^{-1}) = \frac{20.0(A645) + 8.02\,(A663)}{a \times 1000 \times \text{weight of sample (g)}} \times V$$

Where,

a = Length of light path in cell (1cm),

V= Volume of extract in ml,

W=Weight of fresh leaf sample (0.1g)

A= Absorbance in nm (wavelength).

RESULTS AND DISCUSSION

A. Chlorophyll content

The effect of natural farming practices significantly influenced the chlorophyll content of cowpea at 30 and 45 DAS during 2020 and 2021 as well as on pooled data basis.

Chlorophyll content at 30 and 45 DAS. Result revealed of two year pooled data show in (Table 1) maximum chlorophyll content was registered under treatment T_9 (Integrated Crop Management with chemical pesticide) but its effect was found at par with treatment T_7 (AI-NPOF package) and T_8 (Integrated Crop Management without chemical pesticide). It is widely known that appropriate crop fertilization enhances a wide range of physiological and metabolic mechanisms with in plant system. Nitrogen is the most significant mineral nutrient as it is necessary for the biosynthesis of proteins, chlorophyll, and other organic compounds in the plant system (Sarwar *et al.*, 2019). It is the primary component of the coenzymes ATP and ADP, which serve as the plant's energy currency (Singhal *et al.*, 2015). Photosynthetic, protein, phospholipids, and nucleic acid production, membrane transport, and cytoplasm streaming are all affected by phosphorus application. Potassium aids in osmotic and ionic control and serves as a cofactor or activator for numerous enzymes involved in the metabolism of proteins and carbohydrates. Jaybhay *et al.* (2015) and Sarwar *et al.* (2019) obtained a similar outcome, namely an increase in the soybean growth characteristics as a result of the application of organics.

B. NPK content in seed

Result of two year pooled data presented in (Table 2) that the maximum nitrogen phosphorus and potassium content in seed was registered under treatment T_9(Integrated Crop Management with chemical pesticide) but its effect was found at par with treatment T_7 (AI-NPOF package) and T_8 (Integrated Crop Management without chemical pesticide). This was attributed to the increase in the availability of these nutrients in soil due to the combined addition of both organic and inorganic sources of nutrients and also conversion of unavailable form of nitrogen into available forms. Similar results were reported by Debele *et al*. (2001); Singhal *et al.* (2015); Sharma *et al.* (2017).

Organic manure increased the availability of nitrogen, phosphorus and potassium in seed and haulm by biological nitrogen fixation, resulting in higher nitrogen phosphorus and nitrogenase concentrations. It also encourages the production of growth-promoting hormones. This also resulted in better utilization of other nutrients like phosphorus by plants.

Table 1: Effect of different natural farming practices on chlorophyll content of cowpea during 2020 and 2021.

Treatments	Chlorophyll content (mg g^{-1})					
	At 30 DAS			At 45 DAS		
	2020	2021	Pooled	2020	2021	Pooled
T_1-(Control)	1.58	1.50	1.54	1.71	1.63	1.67
T_2-Complete NF (1. Beejamrit + Ghanjeevamrit + Jeevamrit; 2. Crop residue mulching; 3. Intercropping; 4. Whapasa)	2.05	2.08	2.07	2.19	2.21	2.20
T_3-NF without 1 (Beejamrit + Ghanjeevamrit + Jeevamrit)	1.94	1.95	1.95	2.07	2.08	2.08
T_4 -NF without 2 (Crop residue mulching)	1.95	1.97	1.96	2.08	2.10	2.09
T_5 -NF without 3 (Intercropping)	2.03	2.10	2.07	2.16	2.23	2.20
T_6 -NF without 4 (Whapasa)	2.04	2.07	2.06	2.17	2.20	2.19
T_7-AI-NPOF package	2.28	2.31	2.30	2.46	2.49	2.48
T_8-Integrated Crop Management (50 % nutrient application through organic manures and 50% nutrient application through inorganic sources with use of Neemaster, Agniaster for pest management	2.27	2.34	2.31	2.45	2.52	2.49
T_9-Integrated Crop Management (50 % nutrient application through organic manures and 50% nutrient application through inorganic sources with application of need based pesticides for pest management	2.26	2.38	2.32	2.44	2.56	2.50
SEm+	0.08	0.09	0.06	0.08	0.10	0.06
CD (P=0.05)	0.23	0.26	0.16	0.25	0.29	0.18

Table 2: Effect of different natural farming practices on nitrogen phosphorus and potassium content in seed of cowpea during 2020 and 2021.

Treatments	Nutrient content in seed (%)								
	Nitrogen			Phosphorus			Potassium		
	2020	2021	Pooled	2020	2021	Pooled	2020	2021	Pooled
T_1–Control	2.740	2.680	2.710	0.309	0.285	0.297	0.992	1.051	1.022
T_2-Complete NF (1. Beejamrit + Ghanjeevamrit + Jeevamrit; 2. Crop residue mulching; 3. Intercropping; 4. Whapasa)	3.100	3.145	3.122	0.377	0.380	0.379	1.170	1.295	1.232
T_3-NF without 1 (Beejamrit + Ghanjeevamrit + Jeevamrit)	3.030	3.039	3.035	0.321	0.322	0.321	1.137	1.202	1.169
T_4-NF without 2 (Crop residue mulching)	3.040	3.097	3.069	0.338	0.340	0.339	1.146	1.236	1.191
T_5-NF without 3 (Intercropping)	3.111	3.187	3.149	0.380	0.385	0.383	1.207	1.315	1.261
T_6-NF without 4 (Whapasa)	3.080	3.130	3.105	0.377	0.379	0.378	1.160	1.234	1.197
T_7-AI-NPOF package	3.310	3.325	3.318	0.397	0.400	0.399	1.290	1.368	1.329
T_8-Integrated Crop Management (50 % nutrient application through organic manures and 50% nutrient application through inorganic sources with use of Neemaster, Agniaster for pest management)	3.300	3.360	3.330	0.396	0.403	0.400	1.267	1.394	1.331
T_9-Integrated Crop Management (50 % nutrient application through organic manures and 50% nutrient application through inorganic sources with application of need based pesticides for pest management)	3.293	3.389	3.341	0.395	0.408	0.401	1.262	1.418	1.340
SEm+	0.049	0.069	0.042	0.004	0.005	0.003	0.018	0.021	0.014
CD (P=0.05)	0.146	0.207	0.122	0.012	0.016	0.009	0.053	0.063	0.039

C. NPK content in haulm

Result of two year pooled data presented in (Table 3) that the maximum nitrogen phosphorus and potassium content in haulm was registered under treatment T_9 (Integrated Crop Management with chemical pesticide) but its effect was found at par with treatment T_7 (AI-NPOF package) and T_8 (Integrated Crop Management without chemical pesticide). The concentration of nutrients in the plant is directly related to its availability in the root zone and growth of the plant. The use of organic manure and inorganic fertilizers considerably enhanced nitrogen and phosphorus concentrations in grain and stover. The similar result were in conformity with Verma *et al.* (2017) and Umadevi *et al.* (2019).

Table 3: Effect of different natural farming practices on nitrogen phosphorus and potassium content in haulm of cowpea during 2020 and 2021.

Treatments	Nutrient content in haulm (%)								
	Nitrogen			Phosphorus			Potassium		
	2020	2021	Pooled	2020	2021	Pooled	2020	2021	Pooled
T_1–Control	1.094	1.025	1.059	0.175	0.169	0.172	1.402	1.394	1.398
T_2-Complete NF (1. Beejamrit + Ghanjeevamrit + Jeevamrit; 2. Crop residue mulching; 3. Intercropping; 4. Whapasa)	1.180	1.249	1.214	0.214	0.219	0.216	1.642	1.680	1.661
T_3-NF without 1 (Beejamrit + Ghanjeevamrit + Jeevamrit)	1.120	1.130	1.125	0.194	0.196	0.195	1.572	1.590	1.581
T_4-NF without 2 (Crop residue mulching)	1.140	1.200	1.170	0.209	0.211	0.210	1.602	1.626	1.614
T_5-NF without 3 (Intercropping)	1.190	1.280	1.235	0.216	0.220	0.218	1.662	1.719	1.691
T_6-NF without 4 (Whapasa)	1.180	1.221	1.200	0.213	0.218	0.216	1.642	1.664	1.653
T_7-AI-NPOF package	1.420	1.425	1.423	0.236	0.241	0.239	1.840	1.854	1.847
T_8-Integrated Crop Management (50 % nutrient application through organic manures and 50% nutrient application through inorganic sources with use of Neemaster, Agniaster for pest management)	1.400	1.461	1.431	0.235	0.240	0.237	1.817	1.903	1.860
T_9-Integrated Crop Management (50 % nutrient application through organic manures and 50% nutrient application through inorganic sources with application of need based pesticides for pest management)	1.390	1.485	1.438	0.234	0.246	0.240	1.825	1.913	1.869
SEm+	0.031	0.038	0.024	0.002	0.003	0.002	0.031	0.054	0.031
CD (P=0.05)	0.094	0.113	0.071	0.005	0.010	0.006	0.094	0.162	0.090

CONCLUSION

Based on the two years of investigation, it is inferred that T_9 (Integrated Crop Management with chemical pesticide) the best treatment for enhancing the NPK and chlorophyll content of cowpea. Hence, the combined application of organic and inorganic fertilizers in equal proportion to supply the recommended level of nitrogen not only increased the chlorophyll content of crops but also enhanced the nutrients availability in soil and their content in crops.

FUTURE SCOPE

The need to protect the environment has arisen and it is important to understand the key areas where all the countries have to look upon and work.

Shifting towards healthier diets

•Ensuring the supply of safe, nutritious food to all through increasing agricultural productivity on existing crop and pasture land and making it more resilient to climatic extremes

• Preserving the environment through systems management principles that increase resource efficiency, reduce net carbon emissions and other pollutants associated with agriculture and improve soils and conserve natural resources

• Reducing food losses and waste

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