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Effect of drip irrigation levels and cowpea (*Vigna unguiculata* L. Walp.) varieties on nutrient uptake, yield and economic returns under arid conditions

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Abstract

Cowpea (*Vigna unguiculata* L. Walp.) is an important legume cultivated for tender pods, dry grain, green manure, fodder and as a cover crop. Crop productivity in arid regions is strongly influenced by water availability, irrigation scheduling and varietal selection. This study aimed to evaluate the effects of different drip irrigation levels and cowpea varieties on nutrient uptake, yield and economic returns under arid conditions. Therefore, a field experiment was conducted during kharif seasons of 2019 and 2020 at the Instructional Farm, College of Agriculture, Swami Keshwanand Rajasthan Agricultural University (SKRAU), Bikaner, Rajasthan. The experiment was laid out in a split-plot design with four irrigation levels based on pan evaporation (PE) 40 %, 60 %, 80 % and 100 %) as main-plot treatments and four cowpea varieties (Kashi Nidhi, Kashi Kanchan, Pusa Sukomal and Swarna Mukut) as sub-plot treatments, with 3 replications. Irrigation at 80 % PE resulted in higher nitrogen (N), phosphorus (P) and potassium (K) contents in pods, comparable to those obtained with 100 % PE irrigation. Furthermore, irrigation at 80 % PE resulted in higher N, P and K uptake in pods, as well as higher pod yield, in both 2019 and 2020, with values statistically at par with those obtained under 100 % PE irrigation. The highest net returns and B : C ratio were obtained with 80 % PE irrigation. Among the varieties, Swarna Mukut recorded the highest pod yield, nutrient uptake and economic returns. The findings indicate that drip irrigation at 80 % PE provides an optimal balance between water use and crop performance. This irrigation level enhances nutrient content, nutrient uptake, productivity and profitability of cowpea under arid conditions without the need for excessive water application.

Keywords: cowpea; drip irrigation; economics; growth; nutrient uptake; pan evaporation

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Introduction

Cowpea (*Vigna unguiculata* L. Walp.) is an important vegetable and pulse crop cultivated for its tender pods, dry grains, fodder and green manure because of its high nutritional value and nitrogen (N)-fixing ability. It is rich in protein, vitamins and minerals and plays a significant role in nutritional security and sustainable agriculture due to its N-fixing ability (1). It is native to Africa and is widely cultivated in India and all over the world. Depending on the cultivar, cowpea is cultivated for vegetable pods, dry grain, forage and green manure (2). The crop exhibits vigorous vegetative growth, which provides extensive ground cover and helps control soil erosion in erosion-prone areas. The crop residues can subsequently be incorporated into the soil as green manure. It has been considered an alternative pulse crop in dryland farming (3).

Despite its adaptability to arid and semi-arid conditions, cowpea productivity is often limited by moisture stress, particularly during critical growth stages. Moisture availability during flowering and pod development largely determines pod yield and nutrient uptake. Appropriate irrigation scheduling and efficient irrigation methods are essential for maximising crop productivity under arid conditions. The quantity of water used by the crop and lost through soil evaporation and plant transpiration (evapotranspiration) during the growth period is a major factor determining crop yield. Irrigation scheduling based on crop water demand

improves water-use efficiency while maintaining productivity (4, 5).

Drip irrigation is an efficient irrigation method that delivers water directly to the root zone. This reduces evaporation losses and improves fertiliser-use efficiency. Drip irrigation systems are particularly useful for vegetable production in arid regions, where they can help reduce input costs (6). Among the various factors of production, irrigation and nutrition management play central roles in increasing cowpea production. Drip irrigation, combined with scheduling based on pan evaporation (PE), offers a precise and efficient method of water application (7). However, both deficit and excess irrigation can adversely affect growth, yield and nutrient uptake.

In addition, varietal performance varies with irrigation regimes and agroclimatic conditions. Varietal differences in cowpea have shown different responses to different irrigation levels (8). The selection of a suitable variety for a particular region plays an important role in improving crop growth, development, productivity and farmers' profitability. Therefore, the identification of an optimum irrigation level and a suitable variety is crucial for enhancing productivity and profitability in each region. Limited information is available on the combined influence of drip irrigation levels and vegetable cowpea varieties under the arid conditions of western Rajasthan (9, 10). Therefore, this study evaluated the effects of irrigation levels and varietal selection on nutrient uptake, yield and economic returns.

Materials and Methods

The field experiment was conducted at the Agronomy Farm, College of Agriculture, Swami Keshwanand Rajasthan Agricultural University (SKRAU), Bikaner, Rajasthan, India. The experimental site is located at 28°01′ N latitude and 73°22′ E longitude, with an altitude of 234.7 m above mean sea level. The region has a hot arid climate, characterised by extremely high temperatures during summer and low temperatures during winter, along with dry winds and high evaporative demand. The annual rainfall ranges from 250–260 mm, most of which is received during the monsoon period (July–September). The crop was sown during the kharif seasons of 2019 and 2020.

The experiment was laid out in a split-plot design with 3 replications. The main-plot treatments consisted of four irrigation levels, namely, I_1 : 40 % PE, I_2 : 60 % PE, I_3 : 80 % PE and I_4 : 100 % PE. The sub-plot treatments comprised four cowpea varieties, namely, Kashi Nidhi, Kashi Kanchan, Pusa Sukomal and Swarna Mukut. The experiment comprised 16 treatment combinations, each replicated 3 times, resulting in a total of 48 plots. Each plot measured 2.7 × 2.4 m (6.48 m^2). The crop was sown on 9 July 2019 and 4 July 2020**,** respectively, under the agro-climatic conditions of Bikaner, Rajasthan. During the second year, the crop was sown at a spacing of 30 × 60 cm in paired rows, with a plant-to-plant spacing of 15 cm. Well-decomposed farmyard manure at the rate of 15 t ha^{-1} was applied at the time of field preparation. A recommended dose of fertilisers (30 : 60 : 60 kg N : P_2O_5 : K_2O ha^{-1}) was applied, of which 15 : 45 : 45 kg ha^{-1} was applied as basal fertiliser through urea, diammonium phosphate (DAP) and muriate of potash (MOP) and the remaining nutrients were supplied through fertigation using a 19 : 19 : 19 water-soluble fertiliser (Table 1).

Irrigation was scheduled based on PE. A pre-sowing irrigation of 25 mm was applied before sowing the seeds. Irrigations through drip irrigation were scheduled on alternate days according to the respective treatments. The quantity of water applied was calculated as follows:

Irrigation water (mm) = PE × Irrigation level Eq. (1)

where, PE = pan evaporation (mm). The lateral drip lines were laid on the soil surface at a line-to-line spacing of 100 cm. The spacing between drippers was 30 cm, with a discharge rate of 4 L ha^{-1}.

Nitrogen, phosphorus and potassium uptake (kg ha^{-1})

Representative green pod samples were collected from each treatment, washed thoroughly with distilled water and oven-dried at 60 ± 2 °C until a constant weight was attained. The dried samples were ground to a fine powder and used for nutrient estimation. For phosphorus (P) and potassium (K) estimation, the powdered samples were wet-digested using a di-acid mixture of nitric oxide (HNO_3) and perchloric acid ($HClO_4$) (9 : 4, v/v). Total N was estimated by the modified micro-Kjeldahl method, P by the vanado-molybdate phosphoric acid yellow-colour method and K using a flame photometer. Nitrogen, P and K uptake (kg ha^{-1}) were computed by multiplying the respective nutrient concentration (%) by the corresponding dry matter yield and expressing the values on a hectare basis. Nitrogen content was determined by the Kjeldahl method (11), P by the vanado-molybdate yellow colour method (12) and K using a flame photometer (12).

Pod harvesting and yield estimation

Green mature pods were manually harvested when the seeds were tender and green. Harvesting was carried out through successive pickings from 19 August to 11 October 2019 and from 20 August to 9 October 2020. The produce obtained from all pickings was summed to determine the total green pod yield, which was expressed in quintals per hectare (q ha^{-1}).

Benefit : cost (B : C) ratio

The B : C ratio was calculated as follows (13):

B : C ratio = Gross returns (₹ ha^{-1})/Cost of Cultivation (₹ ha^{-1}) Eq. (2)

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Table 1. Initial physical and chemical properties of the soil at the experimental site

Soil properties	Value (0–30cm)
A. Mechanical composition	
Sand (%)	82.71
Silt (%)	10.59
Clay (%)	6.71
Texture	Loamy sand
B. Physical properties	
Organic carbon (%)	0.12
Available N (kg ha^{-1})	117
Available P_2O_5 (kg ha^{-1})	15.4
Available K_2O (kg ha^{-1})	172.7
EC (dS m^{-1}) (1 : 2 soil-watersuspension at 25 ºC)	0.16
Soil pH (1:2 soil–water suspension at 25 ºC)	8.5
C. Chemical properties	
Organic carbon (%)	0.12
Available N (kg ha^{-1})	117
Available P_2O_5 (kg ha^{-1})	15.4
Available K_2O (kg ha^{-1})	172.7
EC (dS m^{-1}) (1 : 2 soil–watersuspension at 25 ºC)	0.16
Soil pH (1 : 2 soil–watersuspension at 25 ºC)	8.5

Statistical analysis

The data were subjected to analysis of variance (ANOVA) appropriate for a split-plot design with 3 replications. The significance of treatment effects was tested at the 5 % probability level ($p < 0.05$). The standard error of the mean (S.Em. ±) and critical difference (CD) at the 5 % significance level were calculated for comparison of treatment means. Statistical analyses were performed using ANOVA and graphs were prepared using graphical representation and analysis of plant experiments (GRAPES) 1.1.0 software.

Economic analysis

Gross returns were calculated from the value of green pod yield. Net returns were calculated by subtracting the cost of cultivation from gross returns, while the B : C ratio was calculated as the ratio of gross returns to cost of cultivation. The cost of cultivation included the expenditure incurred on labour, fertilisers and other inputs, field operations and irrigation.

Results and Discussion

Effect of irrigation levels and varieties on nutrient content of cowpea

The N, P and K contents in cowpea pods were significantly influenced by irrigation levels during both experimental years (Table 2). Nitrogen content increased with increasing irrigation levels. Significantly higher N content in cowpea pods was recorded at the 80 % PE irrigation level (1.416 and 1.400 %) than at the 60 % and 40 % PE irrigation levels, but it was statistically at par with that at the 100 % PE level (1.399 and 1.400 %) during 2019 and 2020. The significantly highest P content in pods was recorded at the 100 % PE irrigation level (0.469 and 0.476 %), which was significantly higher than that at the 60 % and 40 % PE levels but statistically at par with that at the 80 % PE irrigation level in 2019 and 2020. The maximum K content in cowpea pods was obtained at the 100 % PE irrigation level (1.347 and 1.352 %), which was significantly higher than that at the 60 % and 40 % PE irrigation levels but statistically at par with that at the 80 % PE irrigation level (1.335 and 1.338 %). The lowest K content (1.047 and 1.055 %) in cowpea pods was obtained at the 40 % PE irrigation level in both years (2019 and 2020). Better crop performance under this treatment might be due to adequate moisture supply, which enhanced nutrient availability and uptake (14). The better performance under the 80 % PE irrigation level may be attributed to optimum soil moisture availability, which promoted nutrient absorption and efficient movement of nutrients within the plant system (15). Reduced nutrient uptake at lower irrigation levels can be attributed to limited nutrient mobility under moisture stress conditions (16).

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Table 2. Effect of irrigation levels and varieties on nutrient content of cowpea

Treatments	Nitrogen content (%)		Phosphorus content (%)		Potassium content (%)	
	2019	2020	2019	2020	2019	2020
Irrigation levels						
40 % of PE	1.097	1.103	0.366	0.376	1.047	1.055
60 % of PE	1.269	1.276	0.423	0.433	1.211	1.220
80 % of PE	1.416	1.415	0.469	0.476	1.347	1. 352
100 % of PE	1.399	1.400	0.464	0.474	1.335	1.338
S.Em. ±	0.025	0.024	0.008	0.008	0.024	0.023
CD at 5 %	0.086	0.084	0.028	0.028	0.082	0.080
Varieties						
Kashi Nidhi	1.315	1.323	0.438	0.446	1.251	1.260
Kashi Kanchan	1.300	1.307	0.433	0.441	1.238	1.245
Pusa Sukomal	1.279	1.278	0.424	0.434	1.219	1.224
Swarna Mukut	1.286	1.286	0.427	0.438	1.231	1.236
S.Em. ±	0.022	0.020	0.007	0.007	0.021	0.019
CD at 5 %	NS	NS	NS	NS	NS	NS

PE: pan evaporation; S.Em.: standard error of the mean; CD: critical difference; NS: not significant.

In case of sub-plot treatment, N, P and K contents were non-significantly affected by cowpea varieties for the year 2019 and 2020.However, the highest N content in cowpea pods (1.315 and 1.323 %) was recorded in Kashi Nidhi, followed by Kashi Kanchan, Swarna Mukut and Pusa Sukomal during 2019 and 2020. The variety Kashi Nidhi also had the highest P content in pods (0.438 and 0.446 %), followed by Kashi Kanchan, Swarna Mukut and Pusa Sukomal during both years. The highest K content was recorded in Kashi Nidhi (1.251 and 1.260), followed by Kashi Kanchan, Swarna Mukut and Pusa Sukomal during both years. Kashi Nidhi was superior in nutrient content, whereas Swarna Mukut was superior in nutrient uptake and pod yield due to better growth and efficient nutrient utilisation. Nitrogen and K contents showed non-significant differences among varieties because the variation among varietal means was very negligible and remained within the critical difference limit, indicating similar genetic potential for nutrient absorption and accumulation. However, P content exhibited non-significant variation due to differences in root architecture and P use efficiency among genotypes (17). The better performance of Kashi Nidhi and Swarna Mukut may be attributed to their efficient root systems, superior nutrient absorption capacity and better utilisation of available nutrients, which contributed to higher nutrient content, uptake and pod yield (18).

Effect of drip irrigation levels and cowpea varieties on nutrient uptake and pod yield of cowpea

Nitrogen, P and K uptake by cowpea pods increased significantly with increasing irrigation levels during both experimental years (Table 3). The maximum N uptake by pods (33.12 and 33.69 kg ha^{-1}) was recorded under the 80 % PE irrigation level, which was significantly higher than that under the 60 % and 40 % PE irrigation levels but statistically at par with that under 100 % PE (33.02, 33.96 and 33.49 kg ha^{-1}) during 2019 and 2020, respectively. The minimum N uptake (12.91 and 12.97 kg ha^{-1}) by cowpea pods was observed under the 40 % PE irrigation level during both years. The maximum P uptake by pods (11.00 and 11.42 kg ha^{-1}) was recorded under the 80 % PE irrigation level, which was significantly higher than that under the 60 % and 40 % PE irrigation levels but statistically at par with that under 100 % PE (10.93 and 11.41 kg ha^{-1}) during 2019 and 2020, respectively. The minimum P uptake (4.30 and 4.41 kg ha^{-1}) by pods were observed under the 40 % PE irrigation level during both years. Significantly higher K uptake by cowpea pods (31.60 and 32.46 kg ha^{-1}) was recorded under the 80 % PE irrigation level, which was significantly higher than that under the 60 % and 40 % PE irrigation levels but statistically at par with that under 100 % PE (31.41 and 32.21 kg ha^{-1}) during 2019 and 2020, respectively. The minimum K uptake (12.32 and 12.40 kg ha^{-1}) was recorded under the 40 % PE irrigation level during both the years 2019 and 2020. The better response under 80 % PE may be attributed to optimum moisture conditions, which improved nutrient solubility, nutrient absorption and root proliferation. Under moisture stress conditions, lower levels of irrigation resulted in restricted nutrient movement, leading to lower nutrient uptake and yield (19).

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Table 3. Effect of irrigation levels and varieties on nutrient uptake and pod yield of cowpea

Treatments	Nitrogen uptake (kg ha^{-1})		Phosphorus uptake (kg ha^{-1})		Potassium uptake (kg ha^{-1})		Pod yield (q ha^{-1})	
	2019	2020	2019	2020	2019	2020	2019	2020
Irrigation levels								
40 % of PE	12.91	12.97	4.30	4.41	12.32	12.40	78.08	78.47
60 % of PE	23.88	25.02	7.96	8.49	22.80	23.91	125.53	130.42
80 % of PE	33.12	33.69	11.00	11.42	31.60	32.46	158.11	160.34
100 % of PE	33.02	33.96	10.93	11.41	31.41	32.21	155.67	159.80
S.Em. ±	0.88	0.98	0.30	0.33	0.83	0.93	2.23	1.79
CD at 5 %	3.03	3.38	1.02	1.14	2.87	3.21	7.73	6.20
Varieties								
Kashi Nidhi	29.15	29.78	9.71	10.03	27.75	28.36	146.21	148.90
Kashi Kanchan	23.53	24.92	7.84	8.39	22.39	23.73	116.19	121.68
Pusa Sukomal	19.88	20.43	6.59	6.93	18.94	19.56	101.22	104.32
Swarna Mukut	30.36	30.50	10.07	10.39	29.05	29.32	153.75	154.14
S.Em. ±	0.81	0.79	0.27	0.27	0.77	0.75	1.59	1.57
CD at 5 %	2.37	2.31	0.80	0.78	2.26	2.19	4.65	4.59

PE: pan evaporation; S.Em.: standard error of the mean; CD: critical difference.

Nitrogen, P and K uptake by vegetable cowpea varied among varieties during both experimental years (2019 and 2020) in the subplot treatments. Swarna Mukut recorded significantly higher N uptake (30.36 and 30.50 kg ha^{-1}) over the varieties Kashi Kanchan and Pusa Sukomal but was statistically at par with Kashi Nidhi during both experimental years. Swarna Mukut recorded significantly higher P uptake by pods (10.07 and 10.39 kg ha^{-1}) as compared to Kashi Kanchan and was statistically at par with Kashi Kanchan during both experimental years. Similarly, Swarna Mukut recorded significantly higher P uptake by cowpea pods (29.05 and 29.32 kg ha$^{-1)}$ over the varieties Kashi Kanchan and Pusa Sukomal but was statistically at par with Kashi Nidhi (27.75 and 28.36 kg ha^{-1}) during both experimental years. The K uptake values recorded by Pusa Sukomal were 18.94 and 19.56 kg ha^{-1}, which represented the lowest values among the varieties grown during the year 2019 and 2020, respectively. Among the varieties, the maximum nutrient uptake and pod yield were recorded by Swarna Mukut, followed by Kashi Nidhi.

Pod yield per hectare was influenced by various irrigation levels (Table 3). Irrigation at 80 % PE resulted in the maximum pod yield per ha (158.11 and 160.34 q ha^{-1}), which was significantly higher than that under the 60 % and 40 % PE irrigation levels in 2019 and 2020, respectively. However, in the sub-plot treatment, the maximum yield of pods per ha was recorded with the Swarna Mukut variety (153.75 and 154.14 q ha^{-1}), which was significantly higher than that recorded with Kashi Nidhi (146.21 and 148.90 q ha^{-1}), Kashi Kanchan (116.19 and 121.68 q ha^{-1}) and Pusa Sukomal (101.22 and 104.32 q ha^{-1}) in 2019 and 2020, respectively The improved performance of Swarna Mukut may be due to its better nutrient use efficiency, higher dry matter production and effective movement of nutrients from source to sink (20). The higher nutrient uptake and pod yield recorded with Swarna Mukut may be due to its better growth performance, efficient utilisation of absorbed nutrients and greater translocation of photosynthates from source to sink (21).

Effect of drip irrigation levels and cowpea varieties on economics returns

Economic returns were significantly influenced by both irrigation level and variety, with 80 % PE irrigation and the variety Swarna Mukut producing the highest net returns and B : C ratio. The economic analysis presented in Table 4 revealed that the maximum net returns (₹183057 and 186790 ha^{-1}) were recorded under the 80 % PE drip irrigation level, whereas the minimum net returns (₹66257 and ₹67318 ha^{-1}) were observed under the 40 % PE irrigation level during 2019 and 2020, respectively. Among the varieties, the maximum net returns (₹177336 and 178320 ha^{-1}) were recorded with Swarna Mukut, which were significantly higher than those recorded with Kashi Nidhi, Kashi Kanchan and Pusa Sukomal. The minimum net returns (₹98541 and ₹103590 ha^{-1}) were recorded with Pusa Sukomal during 2019 and 2020, respectively. Drip irrigation level of 80 % PE recorded the highest benefit–

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cost ratio (4.38 and 4.48), which was significantly higher than that under 100 % PE (4.19 and 4.33). The data revealed that the B : C ratio decreased as the irrigation level increased from 80–100 % PE. The benefit–cost ratio recorded under the 40 % PE irrigation level was 2.30 and 2.34 during 2019 and 2020, respectively. In the case of sub-plot treatments involving different varieties, Swarna Mukut recorded the highest benefit–cost ratio (4.30 and 4.34), which was significantly higher than those recorded with Kashi Nidhi, Kashi Kanchan and Pusa Sukomal during the year 2019 and 2020. The increased economic returns under 80 % PE may be due to higher pod yield, better nutrient uptake and efficient utilisation of available resources under optimum moisture conditions (22). Lower net returns and benefit–cost ratios were recorded under 40 % PE due to reduced yield caused by moisture stress and poor nutrient absorption. The better economic performance of Swarna Mukut may be attributed to its higher pod yield, better growth and efficient nutrient utilisation compared with the other varieties. In contrast, Pusa Sukomal recorded lower net returns and B : C ratio due to its comparatively lower productivity. Appropriate irrigation management, combined with suitable variety selection, contributed to higher pod yield and nutrient uptake in cowpea. The improved results may be attributed to better soil moisture conditions and enhanced nutrient availability to the crop (23, 24).

Correlation between nutrient uptake and pod yield in cowpea

Correlation analysis revealed strong positive relationships between nutrient uptake (N, P and K) and pod yield during both experimental years (Fig. 1). Pod yield was positively correlated with the uptake of N, P and K, suggesting that improved nutrient uptake contributed to higher crop productivity. The treatments that resulted in higher nutrient uptake also produced higher pod yields than the other treatments. The strong positive correlations indicate that greater nutrient uptake was associated with increased pod yield, reflecting improved crop performance under optimum irrigation conditions. This may be attributed to better absorption of nutrients, which led to enhanced plant growth and physiological activities, such as photosynthesis, translocation of nutrients and dry matter accumulation (25).

Conclusion

The present study demonstrated that among the main plot treatments involving different irrigation levels, irrigation at 80 % pan evaporation (PE) proved to be the most efficient, as it maximised nutrient content and uptake, achieved optimum yield as well as maximum economic returns, while maintaining performance comparable to that under 100 % PE irrigation. Among the varieties, Swarna Mukut exhibited superior performance in terms of pod yield, nutrient uptake and economic returns. The combination of optimum irrigation (80 % PE) and a suitable variety (Swarna Mukut) was the most effective in enhancing nutrient content, uptake, productivity, profitability and sustainability in cowpea cultivation. Thus, it can be concluded that efficient irrigation management, combined with appropriate varietal selection, plays a crucial role in improving nutrient content, uptake, yield and economic returns of cowpea under the given conditions. Based on the present findings, irrigation scheduling at 80 % PE combined with the variety Swarna Mukut can be recommended for vegetable cowpea cultivation in arid regions to maximise productivity and profitability while reducing irrigation water use. Future studies should evaluate the long-term performance of this irrigation strategy across different soil types, climatic conditions and growing seasons, while incorporating water-use efficiency and quality parameters.

Table 4. Effect of irrigation levels and varieties on the economics of cowpea cultivation

Treatments	Cost of cultivation (₹ ha^{-1})		Gross returns (₹ ha^{-1})		B : C ratio	
	2019	2020	2019	2020	2019	2020
Irrigation levels						
40 % of PE	50967	50615	117224	117933	2.30	2.34
60 % of PE	52436	52436	188246	196012	3.59	3.76
80 % of PE	54159	54103	237216	240893	4.38	4.48
100 % of PE	55729	54994	233504	239308	4.19	4.33
Varieties						
Kashi Nidhi	53730	53890	219756	224350	4.09	4.20
Kashi Kanchan	53776	53389	174772	183019	3.25	3.43
Pusa Sukomal	54143	54016	152684	157606	2.82	2.93
Swarna Mukut	53738	53487	231074	231807	4.30	4.34

PE: pan evaporation; B : C ratio: benefit–cost ratio.

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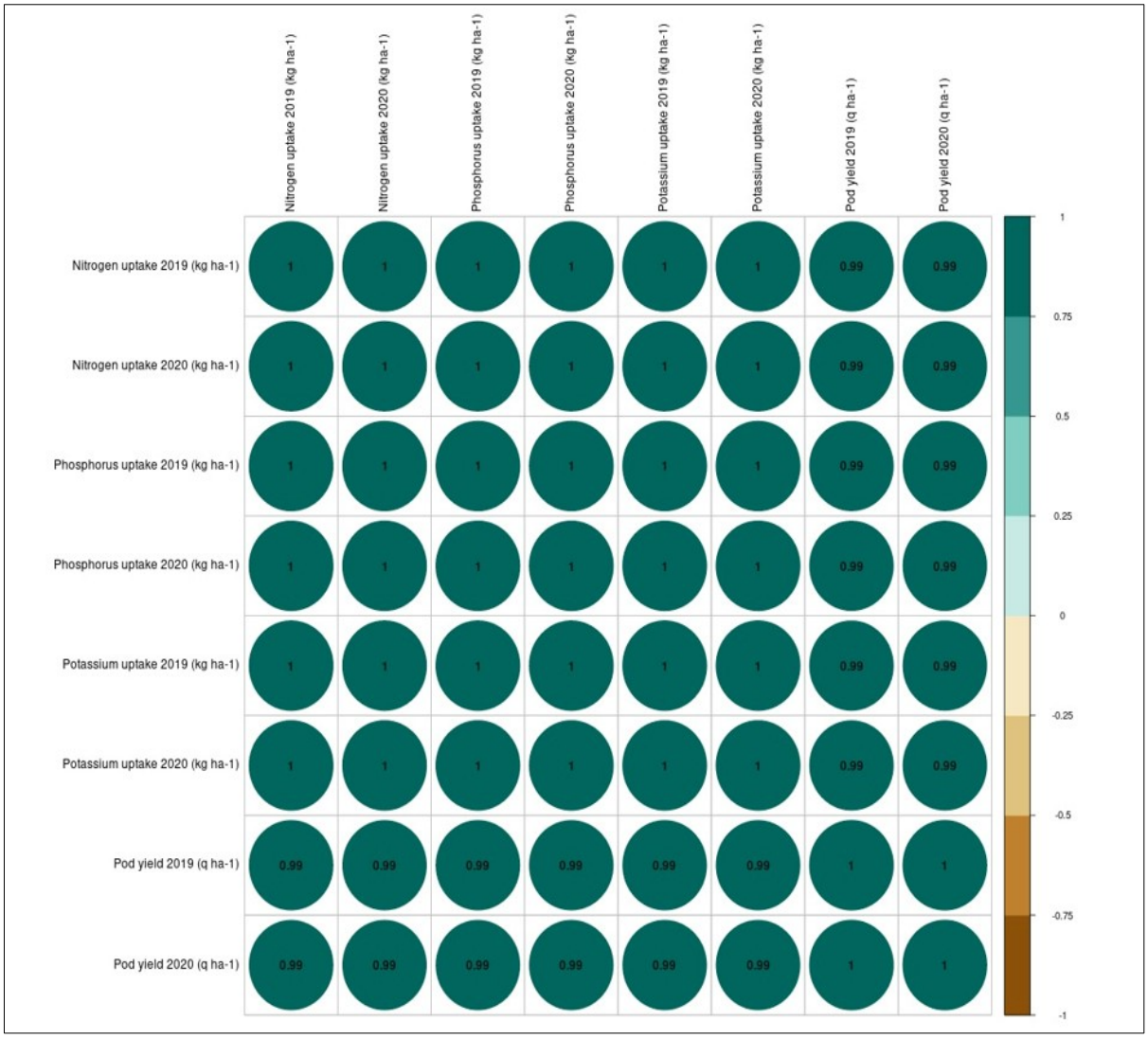


Fig. 1. Correlation analysis of nutrient uptake and pod yield in cowpea under different treatments in 2019 and 2020.

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Authors' contributions

KL conceptualised the study, conducted the field experiment, collected and analysed the data and prepared the original draft of the manuscript. PKY supervised the research, provided technical guidance and critically reviewed the manuscript. ARM assisted with data collection, statistical analysis, interpretation of the results and coordination of the research activities. TM contributed to the literature review, data compilation and manuscript formatting. JG participated in field experimentation, data recording and manuscript review. RS contributed to data interpretation, scientific review and critical revision of the manuscript. KV assisted with the interpretation of the results, manuscript editing and critical review of the scientific content. RK contributed to manuscript writing and editing, interpretation of the findings and served as the corresponding author. All authors read and approved the final manuscript.

Compliance with ethical standards

Conflict of interest

Authors do not have any conflict of interests to declare.

Ethical issues

None

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