Journal Homepage: - www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI: 10.21474/IJAR01/11118
DOI URL: http://dx.doi.org/10.21474/IJAR01/11118

RESEARCH ARTICLE

SOIL TEST CROP RESPONSE CONCENTRATES ON COWPEA (VIGNA UNGUICULATA (L). WALP.) IN MOLLISOL OF UTTARAKHAND, INDIA

Varun Tripathi[1], Sobran Singh[1] and Ajaya Srivastava[2]

1. Department of Agriculture., Invertis University Bareilly.
2. Department of Soil Science, College of Agriculture, G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, 263145, India.

Manuscript Info

Manuscript History
Received: 05 April 2020
Final Accepted: 07 May 2020
Published: June 2020

Key words:-
Soil Test, Manure, Suggestion, One Of A Kind, Judicious,Crop

Abstract

A field dissect was coordinated during spring 2009-2010 of each an Aquic hapludoll at the Norman E. Borlaug Crop Research Center of the G.B. Pant University of Agriculture and Technology, Pantnagar (290 N scope and 79 0 29' E longitude), as indicated by program of All India Coordinated Research Project on the earth test crop response relationship. The preliminary test was coordinated in "two-phases". In the primary stage soil productivity tendency was made by detaching the test field into "three strips" and applying assessed doses of excrements in them (Strip I no fertilizer), Strip II (100, 100 and 100 kg/ha N, P2O5and K2O/ha) independently, and strip III (200, 200 and 200 kg N, P2O5and K2O) exclusively and creating of vapor crop Oat (Var. Kent). In the ensuing stage, for instance next season test crop Cowpea (var. Pant lobia-1) was created by secluding each strip into twenty-four plots having twenty-three fertilizer meds and one control plot. Response to "select" mixes of "three-levels" of FYM (0, 5 and 10 t/ha),"four-levels" of nitrogen (0, 15, 30 and 45 kg/ha), four degrees of phosphorus (0, 30, 60 and 90 kg/ha) and four degrees of potassium (0, 30, 60 and 90 kg/ha) at different readiness levels of cowpea was thought of. The estimations of the common carbon, Alkaline KMnO4 extractable N, Olsen's P and unprejudiced standard Ammonium Acetate extractable K in the test field went between 0.72-1.16 percent, 112.30-200.60 kg/ha, 13.00-24.24 kg/ha and 101.90-245.30 kg/ha, exclusively. In the current assessment indisputably, the straw yield ran from 13.07-24.94 q/ha and full-scale grain yield went from 9.00-18.20 q/ha. Theenhancement needs for making of one quintal of cowpea grain was 5.71 kg of nitrogen, 0.90 kg of phosphorus and 3.72 kg of potassium. Percent duty of nitrogen, phosphorus and potassium was 62.00, 59.00 and 32.00 from soil, however from various sources as FYM was 7.00, 29.00, 10.00; engineered fertilizer 30.00, 14.00 and 30.00 and conjoint usage of substance excrement with FYM 30.00, 17.00 and 27.00 to the extent NPK exclusively. With the help of these data excrement proposition at different yield targets and soil test worth can be resolved. Coefficient of quadratic different backslide (R2) was found incredibly basic (0.898**) between grain yield, soil test regards, included fertilizers and FYM. Normal carbon, solvent KMnO4-N, Olsen's-P and AB DTPA and

Corresponding Author:- Varun Tripathi
Address:- Department of Agriculture., Invertis University Bareilly.

Ammonium acidic corrosive deduction K and AB DTPA K methods for available N, P and K separately were at standard for the cowpea created in Mollisol of Uttarakhand.

……

Introduction:-

Cowpea (Vigna ungiculata (L.) Walp), a yearly vegetable, moreover ordinarily implied as southern pea, dim took a gander at pea, crowder pea, lobia, niebe vehicle or frijole. It is one of the old-fashioned respects man.The chronicled scenery of cowpea dates to old West African grain developing, 5 to 6 thousand years back, where it was immovably associated with the improvement of sorghum and pearl millet. It is also evolved in Latin America, and southern United States. The dull saw cowpea type is grown up in a general sense in California and promoted as California dim looked toward pea. Making of cowpea has extended altogether over the latest 25 years. It is a warm season crop particularly changed in accordance with various zones of the damp tropics and quiet zones. It suffers warmth and dry conditions anyway is extremist of ice. This yield has a huge assurance as an elective heartbeat crop in dry land developing. Cowpea performs best on particularly drained sandy topsoil or sandy soils where soil pH is in the extent of 5.5 to 6.5. Being a leguminous yield, it requires soil utilization of NPK as a starter partition for better early on establishment. In a measure, 3.3 million tons of cowpea dry grains were conveyed by and large during the year 2000. The world ordinary yield was 337 kg/ha (Bressani et al., 1985); IITA, (2000). Inside India, cowpea is created in a zone of 3.9 million hectares with a making of 2.21 million tones and proficiency of 567 kg/ha. Pulses are the critical wellsprings of proteins, supplements, and minerals for the pervasively veggie lover people and are conspicuously known as "poor man's meat" and "rich man's vegetable" (Singh et al., 1992). Essentialnessof compost to construct food grain creation is all around saw. Cultivating creation is raising by the sharp addition in excrement usage, anyway effectiveness increments of included enhancements are declining. Supplement deftly from blend fertilizers is the best approach to fabricate the rustic creation. Updated land gainfulness results from the synergistic effects of engineered manures, common composts, biofertilizers and other locally open enhancement sources, which improve soil regular carbon, and supplement status in this manner substance, physical and natural properties of soil. Since plants get supplements from both soil and fertilizers, it is critical to restrict the wastage of excrement status in the earth to ensure their financial and legitimate use. The need of to use limitless kinds of essentialness have revived the use of normal composts the world over. Enhancements contained in normal fertilizers are released even more bit by bit and are taken care of for a progressively expanded time in the soil, thusly ensuring a long waiting effect (Sharma et al., 1991). Improvement of characteristic conditions and general prosperity similarly as the need to diminish the cost of rewarding harvests are moreover critical purposes behind pushing extended use of normal materials (Seifritz, 1982). Usage of common manures in like manner improves the soil microbial properties (Belay et al., 2001). The points of interest sensible from the occupations of characteristic materials have in any case not been totally utilized in the moist tropics in view of tremendous sums required to satisfy the dietary needs of yields similarly as transportation and managing costs which build up noteworthy goals. They are only from time to time available to the little extension farmers in the important colossal sums (Nyathi etal., 1995). During the post green miracle period, the making of pulses recorded a negative improvement rate. This upsetting example in the production of pulses had inimically affected the per capita openness of pulses. Soil testing is one of the huge mechanical assemblies to gets to the productivity status of soil and give the reason of supplement need for a yields/altering gathering. This helps with smoothing out the cost of fertilizer use and will manufacture the compostuseviability.Soiltestinginlikemannerhelpsinseeingofsoilprosperityandconditionaftersometime.In

the current and future circumstance, soil testing must be renamed as soil quality assessment and it must expect a complete activity not compelled to control fertilizer proposal for a gather reliant on soil test (Goswami 2006). Consequently, the soil testing has become the foundation for rewarding our soils in balanced degree and to fathom supplement incidents from the earth. The earth test regards should be related and adjusted for recommending the compost need of a reap on a specific soil climate zone. Without such information, no precise excrement recommendations would be possible. Keeping these components in observe, an All India encouraged exploration Project on Soil Test Crop Response Correlations was started by the Indian Council of Agricultural Research in the 1967-1968.Various pieces of the issue and approaches for plan were resolved and chitchatted at the national level. Finally point by point specific program endeavored up to oversee lab and field experimentation. In thefield experimentation under this program, the yield assortments due to the board practices and the earth factors other than the enhancement under assessment were kept up a key good ways from by making the perfect productivity assortments erroneously on a comparative field at barely any picked goals addressing diverse soil and agro-climatic zones of the country. Detailing perfect fertilizer proposal for centered yield was first given by (Troug 1960) which further balanced by (Ramamoorthyet al., 1967). The association between yield of money related part and take-up of an enhancement will when in doubt be immediate. This proposes for getting a given yield, a positive measure of the

enhancement must be utilized by the plant. At the point when this essential is seen for a given yield, an unequivocal measure of the enhancement must be utilized by the plant. At the point when this essential is seen for a given yield, the manure need can be evaluated by surveying adequacy or duty from the enhancement open in soil and from the manure applied. The data gained from the Soil Test Crop Response field attempt gives a range in soil test regards, supplement take-up and yield levels, which engages us in calculating the three principal limits for instance supplement necessities, percent duty from the applied enhancement through inorganic or regular sources. Today, we are overwhelmed to hear that Soil Test Crop Response (STCR) based arrangement are getting noticeable quality considering their commonness over spread general fertilizer recommendations. Field fundamentals coordinated in different agro-natural zones with different cutting systems revealed that the STCR made progressively critical returns and keeps up better enhancement status when appeared differently in relation to cover manures proposition. This strategy of capable fertilizer the officials manufactures the creation potential for yield of pulses.

Materials And Methods:-

Field experiment was conducted in B3 block of Norman E. Borlaug Crop Research Centre (C.R.C), of G.B. Pant University of Agriculture and Technology, Pantnagar, Distt. U S. Nagar, Uttarakhand on Soil Test Crop Response Studies as per the technical programme of A.I.C.R.P. During spring2010-11. The Crop Research Centre is situated at the foothills of Shivalik range of Himalayas at 290 N latitude, 790 29' E longitude and an altitude of 243.84 m above the mean sea level. Climate of Pantnagar is humid, subtropical with hot and dry summers and cool winters. The monsoon season usually starts from third or fourth week of June and extends up to last week of September. Few spells of downpours are generally received during winter season (November to march). The average annual rainfall of the area is 1433.3 mm and approx. 80-90 percent of it isreceivedduringrainyseason.Soilsofthis region is developed from medium to moderately coarse textured calcareous alluvium brought down from mountains by numerous streams flowing through Bhabhar and Tarai. These are mainly silty and loamy in texture with weak fine to medium fine granular structure, having good moisture storage capacity and these are considered as a highly productive soil.

Composite soil samples were processed and analyzed for various physicochemical properties (Table 1). In the beginning fertility gradient across the width of field was created by adding different doses of N, P and K fertilizers and growing Oat var.-Kent as exhaust crop, during Rabi 2010. This is for successful soil test crop response correlation study and to minimize the interference of other soil and management factors affecting crop yield response. In the beginning first phase, 2010 land was prepared in the month of September. For preparation of field one-disc ploughing followed by two cross harrowing was done. The field was levelled with the help of tractor drawn leveler to give gentle slope for smooth drainage on the same day. Experimental site was divided into three equal strips and applied three levels of nutrients, viz 0, 1 and 2 (i.e.) N0P0K0, N1P1K1 and N2P2K2 as given in table 2. Nitrogen, phosphorus, and potash were applied as urea, single super phosphate and muriate of potash, respectively. Half dose of nitrogen and full dose of phosphorus and potash were applied by placement method. The remaining half dose of nitrogen was applied 45 DAS. Line sowing was done at 23 cm row to row distance and plant to plant to plant distance 5 cm. Seeds of variety Kent were sown at the rate of 100 kg/ha. For raising the crop recommended agronomic practices were adopted. This crop was harvested at 50 % flowering. During second phase a test crop, Cowpea var. Pant lobia-1 was sown on the site of fertility gradient experiment. Land was prepared with one-disc ploughing followed by four cross harrowing. The field was leveled without disturbing strip boundaries with the help of leveler to furnish gentle slope for better drainage Each strip was divided into 24 plot (23 treated and one control plot) resulting in total seventy two (24×3) plots (3m × 3m size) plots. These treatments comprised of various selected combinations of nitrogen, phosphorus, potassium, and farmyard manure were randomized in each of the three strips. Nitrogen, phosphorus, potassium, and organic manure were applied through urea, single super phosphate muriate of potash and FYM, respectively. Half of nitrogen, total phosphorus, total potash, and total dose of FYM were broadcasted as basal and mix well in soil with spade before sowing. While remaining half of nitrogen was applied 30 DAS. (Table 3). An attempt was made to keep the crop free of weeds, insects, pests, and diseases following the recommended agronomic practices. Soil samples were collected plough layer (0- 15 cm depth) from each plot of strips I, II and III before addition of any manure or fertilizer. Plant samples were collected from each plot at the time of harvest (physiological maturity stage) and were dried to constant weight at 700 C. After threshing of the harvested produce of each plot the grain and straw yield was recorded and reported as q/ha. After recording the grain and straw yield, chemical analysis of soil samples and plant samples was done. After that basic data for fertilizer recommendation was calculated with the help of crop yield, nutrient uptake, and soil test values. After that statistical analysis was done by the method of simple correlation as well as multiple regression equation (Panse and sukhatme, 1962; Snedecor and Cochran, 1967) and as per standard design of AICRP on Soil Test Crop Response Project of ICAR.

Results and Discussion:-

Soil investigation:

Test soil was topsoil delegated Aquic Hapludoll having pH 6.87, Organic carbon 0.76%, Alkaline KMnO4-N 165.07, Olsen's-P 17.69, and Ammonium Acetate-K 274.4 kg/ha. Strip insightful range and mean of soil test esteems got by various soil test strategies for nitrogen, phosphorus and potassium are given in table 4. From this information it was discovered that the nitrogen extricated as antacid KMnO4-N was found in the request, strip III> strip II> strip I (Table 4). Comparative pattern was seen by phosphorus removed by Olsen's technique and potassium extricated by impartial typical ammonium acetic acid derivation potassium in various strips (Table 4). Along these lines, it is reasoned that the Alkaline KMnO4-N, Olsen's-P and impartial ordinary ammonium acetic acid derivation potassiumsubstanceofsoilexpandedintherequestforstripI<stripII<stripIIIoftheexploratorysite.Fromthese information accessibility lists of N, P and K were controlled by relapse conditions utilizing take-up as needy and soil test esteems, compost dosages as free factors.

Accessibility records of nitrogen, phosphorus, and potassium:

Nitrogen was controlled by antacid KMnO4 and natural carbon as file of accessible nitrogen conditions indicating the relationship by these techniques are given beneath:

Organic carbon (%):
UN= 209.487-1.349 FN+0.0232 FN2-244.615SN+108.625SN2+0.916FNSN……(I)
R2= 0.57

Alkaline KMnO4-N:
UN=164.229-1.596 FN+0.00373 FN2- 1.007SN+0.00206SN2+0.0148FNSN…….(II)
R2=0.612**

Assessment of P ripeness status of soil is important to make a sound P manure suggestion for streamlining crop yield. To decide the accessible P status different techniques are utilized by various researcher in most of the dirt testing labs. The rate and amount of P that can be solubilized by an extractants relies upon the dirt and synthetic nature of the extractants utilized. Following different relapse condition created for the assessment of accessible phosphorus
(Table 5 and6).

Olsen's-P:
UP= 4.270-0.332 FP-0.00681FP2+1.110SP-0.00507 SP2+0.00411 FPSP… (III)
R2= 0.607**

Ab-Dtpa:
UP=60.410-0.0748 FP-0.000667 FP2-3.938 SP2+0.07604 SP2+0.00996 FPSP…(IV)
R2=0.596**

Mehlich-P:
UP=-33.464-0.184 FP+0.00138 FP2+1.713 SP-0.0177 SP2+0.00603FPSP… (V)
R2=0.619**

Morgan-P:
UP=-33.464-0.184 FP+0.00138 FP2+1.713 SP-0.0177 SP2+0.00603 FPSP… (VI)
R2=0.673**

Evaluation of K productivity of soil is indispensable for smoothing out fertilizer use and making K excrement recommendation of the yield. Different procedures have been pushed be a couple of workers to measure the available K status of the soils anyway none of these has been viewed as all around material. The K Availability depends on their aggregate in the earth, soil characteristics, temperature, and regular issue content. Following diverse backslide condition made for the evaluation of open potassium.

Neutral ammonium acetate:
UK= 1.403-0.560 FK-0.00276 FK2+0.590 SK-0.00185 SK2+0.0498 FKSK… (VII)
R2= 0.616**

Table 1:- Physicochemical properties of the dirt of exploratory site (0-15 cm. soil profundity).

S. No.	Property	Value obtained	Method employed
1	Textural analysis		
	Sand (%)	50.81	**Bouycous Hydrometer method (Black, 1965)**
	Silt (%)	32.33	
	Clay (%)	16.87	
	Textural class	Loam	
2	pH (1:2.5 soil water suspension)	6.87	**Glass electrode pH meter (Jackson, 1965)**
3	Organic carbon %	0.76	**Walkley and Black method**
4	Available nitrogen (kg/ha)	165.07	**Alkaline KMnO4 method (Subbiah and Asija method, 1956).**
5	Available Phosphorus (kg/ha)	17.69	**Olsen's extraction method (Olsen et al., 1954)**
6	Available Potassium (kg/ha)	274.4	**Neutral one normal ammonium acetate method (Hanway and Hiedal 1952)**

Discussion of the Table:-

From the Bouycos Hydrometer method of (Black, 1965) soil texture was found, and the texture class of the soil was Loam. pH of the soil of the experimental soil was calculated with the help of glass electrode pH meter (Jackson, 1958) in (1:2.5 soil water suspension) and the value of pH was coming to be about in the soil of the experimentalsoil was 6.87(slightly acidic). Organic carbon % value was calculated from (Walkley and Black method) which was found to be around 0.76% (High organic carbon). Available nitrogen (kg/ha) which was calculated with the help of Alkaline KMnO4 method (Subbiah and Asija, 1956). was found to be 165.07 kg/ha (Low Alkaline KMnO4-N). Available phosphorus was calculated with the help of Olsen's extraction method (Olsen et al.,1954) value of available phosphorus was found to be 17.69 kg/ha which was medium in range of available phosphorus. Available potassium was calculated with the help of Neutral one normal ammonium acetate method (Hanway and Hiedal, 1952). Value of available potassium was found to be 274.4 kg/ha which was medium in range.

Table 2: Details of fertilizers applied in fertility gradient experiment

Strip (Symbol)	Nutrient level (kg/ha)		
	N	**P2O5**	**K2O**
I (N0P0K0)	0	0	0
II (N1P1K1)	100	100	100
III (N2P2K2)	200	200	200

Discussion of the table:

The above given table shows the subtleties of composts applied in ripeness angle try. The richness inclination was isolated into three strips for example low, medium, and high as indicated by the degrees of the manure applied to the ripeness angle analyze. In the I strip for example N0P0K0 there was no compost was applied for example no nitrogen, no phosphorus and no potassium was applied. In the second strip for example N1P1K1 there was multiple times more portion when contrasted with strip I for example 100, 100 and 100 of N, P and K, separately. In the third strip there was multiple times more portion of N, P and K when contrasted with strip I for example (N0P0K0)

Table 3:- Different Levels of Nutrients Applied in Test Crop Experiment.

Levels of nutrients	F.Y.M (t/ha)	N (kg/ha)	P_2O_5 (kg/ha)	K_2O (kg/ha)
0	0	0	0	0
1	5	15	30	30
2	10	30	60	60
3	-	45	90	90

Discussion of the table:

The previously mentioned table gives us that what where the supplements levels applied during the test cropanalyze. The table plainly shows that there were three degrees of FYM were applied for example 0, 5 and 10 t/ha of FYM, Nitrogen

portion was around 0, 15, 30 and 45 kg N/ha separately, phosphorus was applied in the portion of 0, 30 60 and 90 kg/ha and potassium was applied in the portion of 0, 30, 60 and 90 kg/ha individually.

Fig 1:- Showing different levels of nutrients applied in test crop experiment.

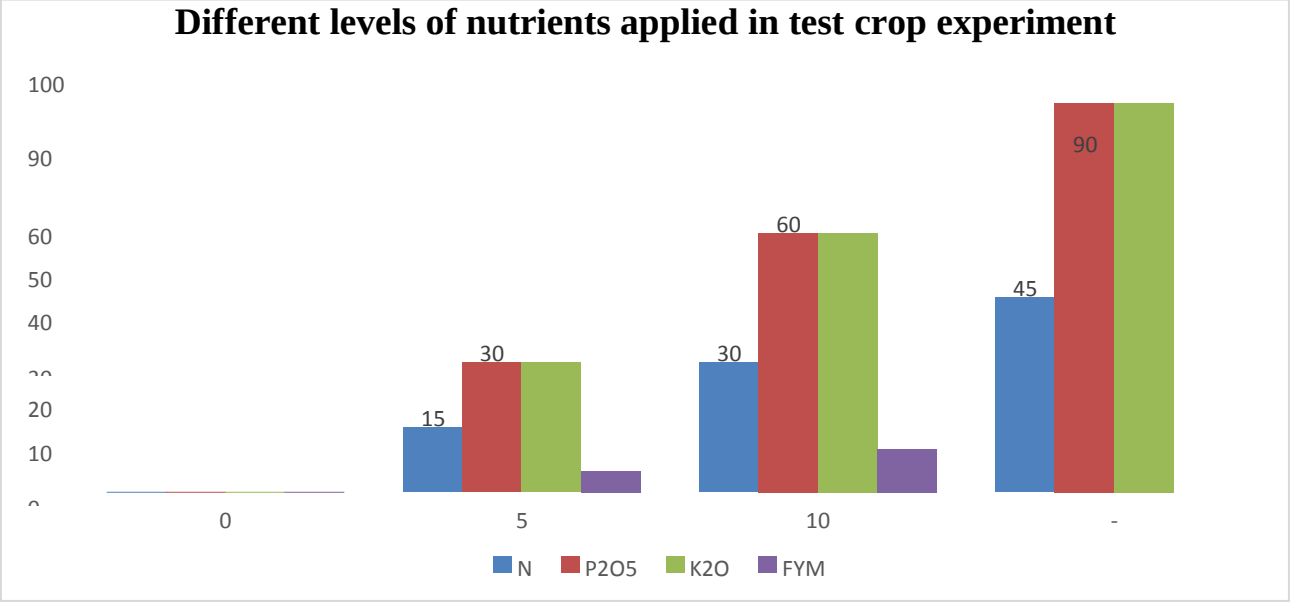

Table 4:- Range and mean of the soil test values obtained under different strips of cowpea.

S No.	Soil test values	Strip I	Strip II	Strip III	Whole field
1	Organic carbon (%)	0.72-1.02 (0.90)	0.74-1.16 (0.99)	0.72-1.15 (0.94)	0.72-1.16 (0.94)
2	Alkaline KMnO4-N (kg/ha)	112.60-178.60 (135.13)	112.30-191.29 (142.84)	112.60-200.60 (146.83)	112.30-200.60 (137.57)
3	Olsen's-P	13.00-23.00 (17.00)	14.60-23.50 (18.61)	15.60-24.24 (20.37)	13.00-24.24 (18.67)
4	Ammonium acetate K	101.90-215.60 (164.28)	120.50-221.50 (176.84)	128.30-245.30 (178.48)	101.90-245.30 (173.28)

Discussion of the table:

The above-mentioned table shows the range and mean of the soil test values under different strips. This table clearly shows the relationship between Organic carbon, Alkaline KmnO4-N, Olsen's-P and ammonium acetate K with differentstrips.OrganiccarboninstripIvariedfrom0.72-1.02withameanof(0.90)instripIIitvariedfrom0.74-1.16 with a mean of (0.99) in strip III it varied from 0.72-1.15 with a mean of (0.94). Among the whole field the organic carbon varied from 0.72-1.16 with a mean of (0.94). Similarly value of Alkaline KMnO4-N value ranged from 112.60-178.60 with a mean of (135.13) in strip I, In strip II the value of Alkaline KMnO4-N value ranged from 112.30-191.29 with a mean value of (142.84), in strip III the value of Alkaline KMnO4-N the value ranged from 112.60-200.60 with a mean value of (146.83). In the whole field the value of Alkaline ammonium nitrogen was found to be around 112.30-200.60 with a mean value of (137.57). Now Olsen's phosphorus in strip I ranged from 13.00-23.00withameanvalueof(17.00)kg/ha,instripIIitvariedfrom14.60-23.50withameanvalueof(18.61)

kg/ha. In strip III it varied from 15.60-24.24 with a mean value of (20.37). In the whole field the value of Olsen's phosphorus ranged from 13.00-24.24 with a mean value of (18.67). The value of Ammonium acetate K ranged from 101.90-215.60 with a mean value of (164.28) in strip I and in strip II120.50-221.50 with a mean value of (176.84) in strip III it varied from 128.30-245.30 with a mean value of (178.48) kg/ha. In the whole field it varied from 101.90-245.30 with a mean value of (173.28).

The order of soil test value in different strips:

1. Organic carbon: Strip II>Strip III> Strip I
2. Alkaline KMnO4-N: Strip I<Strip II<Strip III
3. Olsen's P: Strip I<Strip II<Strip III
4. Ammonium acetate K: Strip I<Strip II<Strip III

Figure 2: Range and mean of the soil test values under different strips

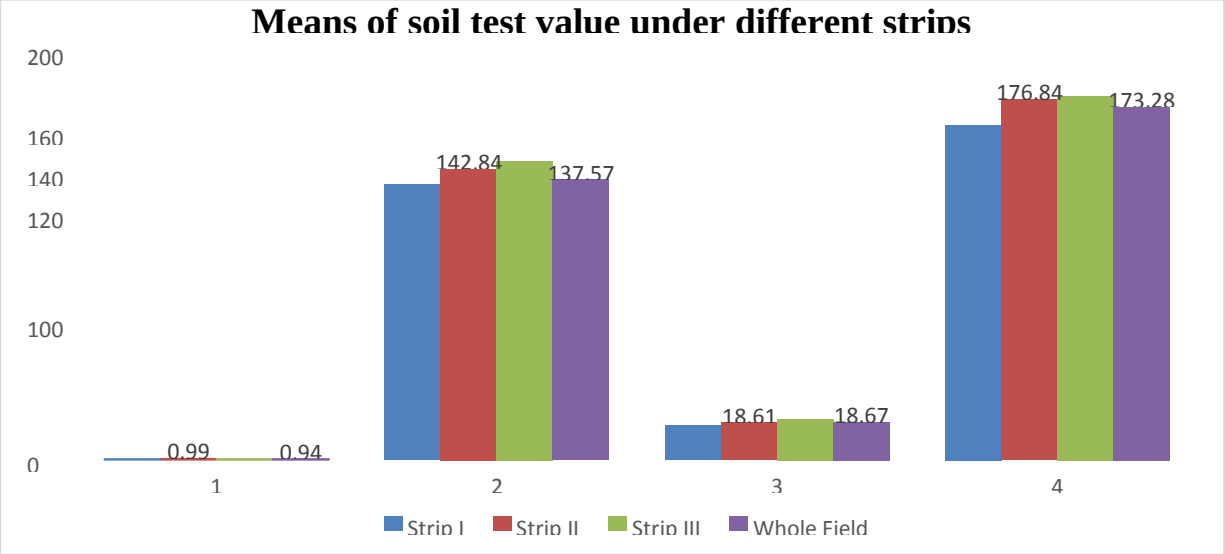

Table 5: Range and average yield of cowpea under different strips.

Particulars	Whole plots			
	Strip I	Strip II	Strip III	Whole Plots
Grain yield	9.00-17.80	11.00-18.00	11.50-18.20	9.00-18.20
(q/ha)	(14.57)	(15.13)	(15.62)	(15.11)
Straw yield	14.10-22.96	13.07-24.94	14.42-23.82	13.07-24.94
(q/ha)	(18.72)	(18.66)	(19.46)	(18.95)
	Control plots			
Grain yield	9.00-12.00	11.00-12.50	11.50-13.50	9.00-13.50
(q/ha)	(10.50)	(11.67)	(12.67)	(11.61)
Straw yield	14.10-15.90	13.07-15.95	14.42-16.17	13.07-16.17
(q/ha)	(15.00)	(14.53)	(15.25)	(14.93)
	Treated plots			
Grain yield	13.10-17.80	13.50-18.00	14.10-18.20	13.10-18.20
(q/ha)	(15.19)	(15.62)	(16.04)	(15.60)
Straw Yield	16.17-22.96	15.09-24.94	16.50-23.82	15.09-24.94
(q/ha)	(19.25)	(19.25)	(20.06)	(19.52)

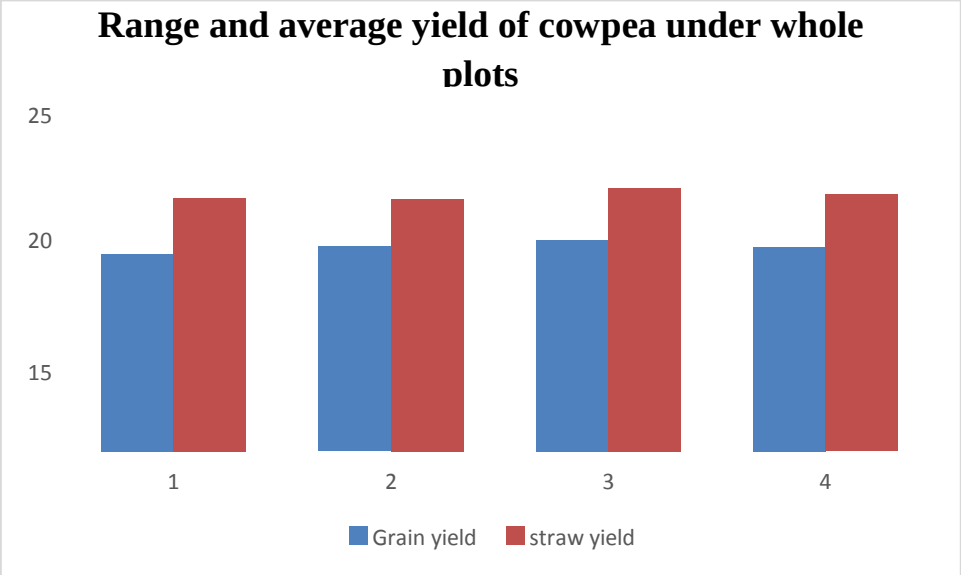

Fig 3:- Range and average yield of cowpea under whole plots.

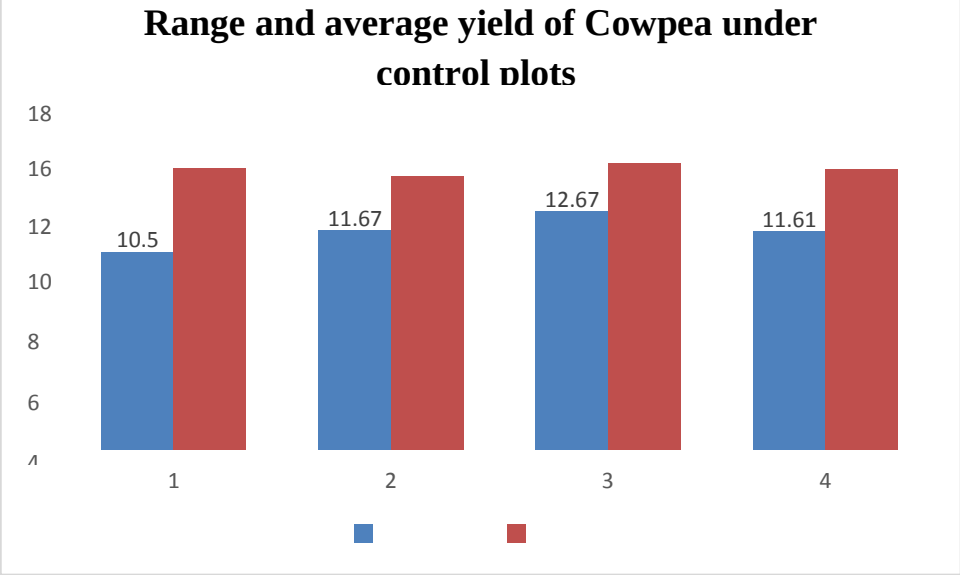

Fig 4:- Range and average yield of cowpea under control plots.

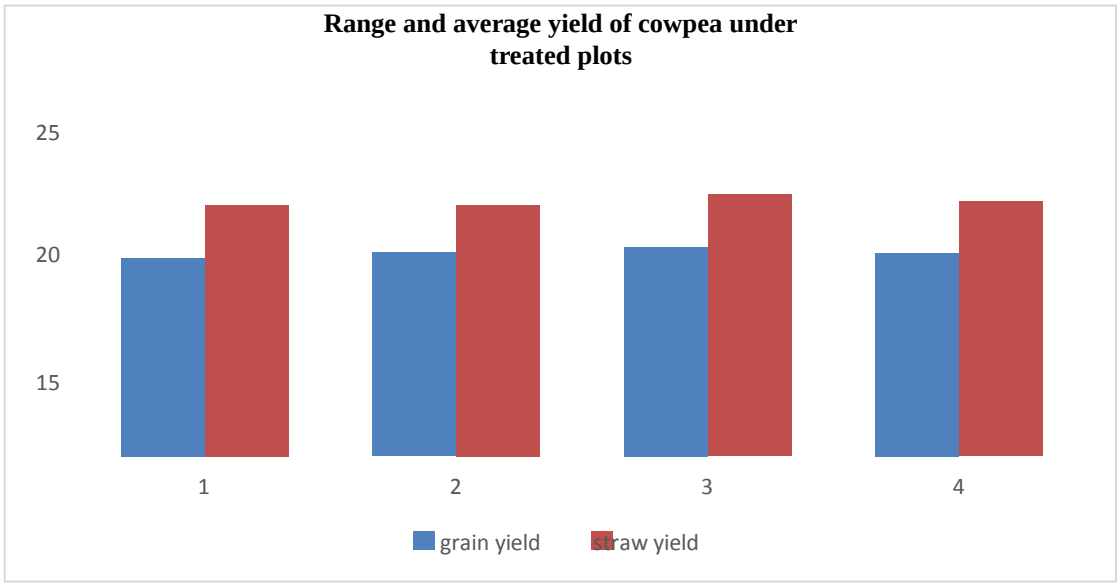

Fig 5:- Range and average yield of cowpea under treated plots.

Table 6:- Basic data for calculating fertilizer dose with and without fym for targeted yield of cowpea.

S. No	Particulars	Without FYM			With FYM		
		N	P	K	N	P	K
1.	Nutrient requirement (kg/q)	5.71	0.90	3.72	5.71	0.90	3.72
2.	Percent contribution from applied soil (%)	62.00	59.00	32.00	62.00	59.00	32.00
3.	Percent contribution from applied fertilizer (%)	30.00	14.00	30.00	30.00	17.00	27.00
4.	Contribution from applied FYM nutrients (%)	--	---	--	7.00	29.00	10.00

AB-Dtpak:
UK=57.776+1.738 FK-0.003 FK2-0.342 SK+0.00159 SK2-0.00807FKSK……(VIII) R2=0.781**

Mehlich-K:
UK=89.50+0.983 FK-0.00019 FK2-0.251 SK- 0.003516 SK2-0.00185 FKSK…. (IX) R2=0.613**

Morgan-K:
UK=51.381+1.415 FK-0.00316 FK2-0.351 SK-0.00264 SK2-0.00954FKSK……(X) R2=0.703**

In the above methods highest R2 was obtained with Alkaline KMnO4 N, Morgan's P and AB-DTPA K.

Fertilizer Adjustment Equations:
Without Fym:
FN=19.03T-2.06 SN FP= 6.42 T-4.21 SP FK= 12.40 T-1.06 SK…(XI)

With Fym:
FN=19.03 T-2.06 SN-0.21 FYM-N FP=6.42 T_4.21 SP-1.64 FYM-P FK=12.4 T-1.06 SK-0.370 FYM-K… (XII)

Refrences:-

1. Belay, A., A.S. Classens, F.C. Wehnerand J.M. De Beer, 2001. Influence of residual manure on selected nutrient elements and microbial composition of soil under long-term crop rotation. South Africa. J. Plant and Soil,18:1-6.
2. Black, C.A. 1965. Methods of soil chemical analysis: Agronomy series. J. Ann. Soc. AgronInc. Madison. Wisconsin. USA. 9(2) pp:44-49.
3. Bressani, Ricardo., 1984. Nutritive value. In: Singh, S.R. and Rachies, K.O., Eds., Cowpea Research Production and Utilization, John Wiley and Sons, New York. pp 50-51.

4. Goswami, P.K.; Bandhopadhyay, K.K.; Misra, R.K. and Subba Rao, A. 2006.Balanced fertilization for maintaining soil health and sustainable agriculture. Ferti News. 49(4):13-24&35.
5. Hanway,J.J and Hiedal, H. 1952. Soil analysis method used in Iowa State Soil Testing Laboratory. Iowa Agric. (c.f. methods of soil analysis, part 2 Ed. C.A. Black., Medison Wisconsin. American Sociof Agron. 57:1025- 1027.
6. IITA (International Institute of Tropical Agriculture) 2000. Annual Report., Ibadan, Nigeria. IITA. pp .66-67.
7. Jackson, M.L.1967. Soil chemical analysis. Prentice Hall of India (P) Ltd., New Delhi. Pp. 183-192.
8. Nyathi, P. and Campbell B.M., 1995. The Effect of Tree Leaf Litter, Manure, Inorganic Fertilizer and their contribution on above-ground production and grain yield of Maize. African Crop Science Journal:3(4):451- 456.
9. Olsen, S.R.; Cole, C.V.; Watanabe, F.S. and Dean, L.A. 1954. Estimation of available phosphorus in soil by extraction with sodium bicarbonate. USDA. Circ. 939pp.
10. Panse, V.G. and Sukhatme, P.V. 1962. Statistical methods for agricultural workers. 2ndedn. New
11. Ramamoorthy, B.; Narasimham, R.L. and Dinesh, R.S. 1967. Fertilizer application for specific yield targets of Sonora 64. Ind. Farming. 17(5) 43-44.
12. Seifritz, A.V. and Singh, J.2004. Revalidation of soil test method of potassium availability in light textured soils of arid and semi-arid regions of north India. Ann. Agri-Bio Res.9(1):99-105.
13. Sharma, A.R. and Mittra, B.N., 1991. Effect of different rates of application of organic and nitrogen fertilizers in a rice- based cropping system. Journal of Agricultural Science (Cambridge).117:313-318.
14. Singh, V. and Singh, B., 1992. Tropical grain legume as important human foods. Economic botany, 1646: 310- 321.
15. Snedeor, G.W. and Cochran, W.G. 1967. Statistical methods 5th ed. Oxford and IBH. Pub. Co. Elton Press, Calcutta. 110-112.
16. Subbiah, B.V. and Asija, G. L. 1956. A rapid procedure for assessment of available nitrogen in rice plots. Curr. Sci., 31:196-200.
17. Troug, E. 1960. Fifty years of soil testing. Transactions of 7th international Congress of Soil Science., Commission IV, Paper No. 3(7): 46-53.
18. Varun Tripathi, Sobran Singh and Bal Mukund Pandey. 2019. Soil Test Crop Response studies onCowpea (Vigna unguiculata(L). Walp.) in Mollisol of Uttarakhand, India. Int.J.Curr.Microbiol.App.Sci. 8(05): 1533-1541. doi: https://doi.org/10.20546/ijcmas.2019.805.177 Delhi. I.C.A.R. pp-56-57.
19. Walkley and Black, C.A. 1934. An examination of different method of determining soil organic Carbon and a proved modification of chromic acid titration method. Soil Sci., 37: 29-38.