

MATERIELS AND METHODS

CHAPTER III

Materials and Methods

The present investigation on the effect of "Tobacco waste management as organic manure and insecticide on chickpea vis-à-vis to other organic manures and bio pesticides" was carried out during the years 2005-2007, at the Experimental Farm, Katheru, Central Tobacco Research Institute, (Indian Council of Agricultural Research) Rajahmundry 533104, Andhra Pradesh, India.

3.1: Location:

The experimental Farm is situated at an latitude of 17° N and Longitude of 81 ° E. The soils are calcareous with montmorillonite deep clay in nature and classified as vertisols. The soils are average in available nitrogen, medium in available phosphorus and rich in potassium. The organic carbon content is low.

These soils possess good water holding capacity and the moisture is held for longer periods to sustain crop growth as the crop chickpea was grown totally on conserved moisture.

The experimental farm is on the eastern side of Godavari, a perennial river. (Fig -1)



Fig.1 Geographical location of Experimental Farm of Central Tobacco Research Institute (Indian council of Agricultural Research) at Katheru in Rajahmundry-533105, East Godavari district, Andhra Pradesh, India.

3.2. Climate:

Katheru farm enjoys a typical tropical climate. The total average annual rain fall was 1100mm. The data on Rain fall, Maximum and minimum temperature are presented in the result part.

3.3. Cropping history:

The crops grown were maize, sorghum, fox tail millet and phaselous sp prior to experimentation.

3.4. Soil chemical properties:

The data on soil chemical properties prior to experimentation were presented in the results part. Similarly, the data after experimentation were also presented appropriately.

3.5. Test crop and variety :

The test crop is chickpea (*Cicer arietinum* L) and the variety is JG-11 with an yield potential of 20.00 q/ha under conserved soil moisture conditions in vertisols (Black Cotton Soils). The variety JG-11 was obtained from authorized seed corporation of Andhra Pradesh (APSSDC) which is suitable for this area.

3.6. Experimental Details :

3.6.1. Lay out details:

Part: A. "Tobacco waste management as organic manure on chickpea productivity vis-à-vis to other organic manures".

The field lay out of the experiment is given here under

REPLICATION-1

M-3		M-5		M-1		M-2		M-4	
20	S-5	21	S-4	60	S-3	61	S-2	100	S-1
19	S-4	22	S-5	59	S-4	62	S-3	99	S-2
18	S-3	23	S-1	58	S-5	63	S-4	98	S-3
17	S-2	24	S-2	57	S-1	64	S-5	97	S-4
16	S-1	25	S-3	56	S-2	65	S-1	96	S-5

REPLICATION-2

M-5		M-4		M-2		M-1		M-3	
15	S-1	26	S-2	55	S-3	66	S-4	95	S-5
14	S-2	27	S-3	54	S-4	67	S-5	94	S-1
13	S-3	28	S-4	53	S-5	68	S-1	93	S-2
12	S-4	29	S-5	52	S-1	69	S-2	92	S-3
11	S-5	30	S-1	51	S-2	70	S-3	91	S-4

REPLICATION-3

M-2		M-1		M-5		M-3		M-4	
10	S-2	31	S-1	50	S-5	71	S-4	90	S-3
9	S-1	32	S-2	49	S-1	72	S-3	89	S-4
8	S-5	33	S-3	48	S-2	73	S-5	88	S-1
7	S-4	34	S-4	47	S-3	74	S-2	87	S-5
6	S-3	35	S-5	46	S-4	75	S-1	86	S-2

REPLICATION-4

M-1		M-3		M-5		M-2		M-4	
5	S-5	36	S-1	45	S-2	76	S-3	85	S-4
4	S-4	37	S-5	44	S-3	77	S-1	84	S-5
3	S-3	38	S-4	43	S-1	78	S-2	83	S-1
2	S-2	39	S-3	42	S-4	79	S-5	82	S-3
1	S-1	40	S-2	41	S-5	80	S-4	81	S-2

M=Main plot treatment,

S=Subplot treatment

3.6.2. Lay-out details:

Design : Split plot Design

Plot size : 4.00 x 4.00 m

Main plots : 5

Sub plots : 5

Replications : 4

3.6.3 .Treatment details:

Main plot:

M-1 FYM@2.5t/ha +Rhizobium+PSB

M-2 FPC@2.5 t/ha +Rhizobium+PSB

M-3 Tobacco stem compost @2.5 t/ha +Rhizobium+PSB

M-4 Soybean trash compost@2.5 t/ha +Rhizobium+PSB

M-5 Control +Rhizobium+PSB

Sub plots. (Recommended dose 20-50-0-15 (N+P+K+S kg/ha)

S-1 50% of the recommended dose of NP.

S-2 75% of the recommended dose of NP.

S-3 100% of the recommended dose of NP.

S-4 100% of the recommended dose of NP + 15 kg Zn So₄

S-5 Absolute control (No organics and inorganics)

Part-B. Tobacco leaf waste management as bio pesticide on chickpea vis-à-vis to other bio pesticide.

3.6.4. Lay out:

The field lay out of the experiment is given here under

Replication-1

6	T-5	7	T-9	18	T-1	19	T-8	30	T-6
5	T-2	8	T-7	17	T-4	20	T-10	29	T-3

Replication-2

4	T-1	9	T-6	16	T-8	21	T-2	28	T-5
3	T-4	10	T-9	15	T-3	22	T-10	27	T-7

Replication-3

2	T-3	11	T-9	14	T-5	23	T-2	26	T-6
1	T-1	12	T-7	13	T-10	24	T-4	25	T-8

3.6.4.1. Lay out details:

Design : Randomised Block Design (RBD)

Plot size : 4.00 x 10.00 m

Replications : 3

3.6.4.2. Treatment details:

The scheduled treatments were applied as foliar sprays

T1. Neem oil @ 2.00 %

T2. Neem seed kernel suspension @ 2.00 %

T 3. Pongamia oil @ 2.00 %

T 4. Pongamia kernel suspensions @ 2.00 %

- T5. HI. NPV @ 250 LE/ha as
- T 6. Kalmegh (*Nela vemu*) extract @ 2.00 %
- T 7. Tobacco waste leaf extract @ 2.00 %
- T 8. Tobacco mid rib extract @ 2.00 %
- T 9. Chlorpyriphos foliar application at 0.2 %
- T10. Control (water spray)
- Number of sprayings : 4
- Time of spraying : At 50, 60, 70 and 80 DAS

3.6.4.3. Larval population:

Larval count (No/m²) was taken at 50, 60, 70 and 80 DAS

3.6.4.4. Harvesting data:

1. Percent damage of pods
2. Total bio mass (t/ha)
3. Total straw (t/ha)
4. Grain yield t/ha.

3.7. Good Agricultural Production Package (GAP):

3.7.1. Preparatory cultivation:

The soil was ploughed twice and harrowed to get good tilth Shivadhar et al., (2008)

3.7.2. Time of sowing:

The seed was sown in the first Fortnight of November

3.7.3. Fertilisers and manures recommended:

The specified organic manures @ 2.5 t /ha and 20 kg Nitrogen as ammonium sulphate ,50 kg phosphorus as SSP and 40 kg elemental sulphur per hectare applied to the crop.

3.7.4. Seed rate:

A seed rate of 75 kg / ha was followed

3.7.5 . Seed treatment with bio fertilisers:

Seed dressing was done with @ 5.00Kg/ha *Trichoderma viride* and 5.00 kg / ha *Rhizobium japonicum*

3.7.6. Depth of sowing:

The seed was drilled in rows spaced at 30 x 10 cm at a depth of 5.0cm.

3.7.7. Inter cultivation:

Intercultivation with harrower followed by hand weeding was done twice at 20 and 40 DAS

3.7.8. Plant protection for part A: Tobacco waste management as organic manure.

Endosulfan at 1.5 ml/l, Chlorpyrifos at 2 ml/l and Acephate at 1.00 g/l water was sprayed at the time of flowering at 15 days time interval

3.7.9. Harvesting and threshing:

The crop was harvested when the hulms were totally dry. The seed was recorded after threshing.

3.8: Growth parameters:

A total number of five plants were randomly selected and the observations were recorded at 45 DAS.

3.8.1. Plant height:

Measured and presented as cm/plant

3.8.2. No of branches:

Main branches were counted and presented per plant basis

3.8. 3. Shoot weight:

Fresh shoot weight was recorded and presented as per plant basis

3.8.4. Root length:

Root length was measured and presented as per plant basis

3.8. 5. Root weight:

Fresh root weight was recorded and presented as per plant-basis

3.8. 6. Number of Bacterial nodules/plant:

Total effective bacterial nodules were counted and presented as per plant basis

3.8. 7. Nodule weight:

The fresh weight of nodules was taken and presented as g/plant basis

3.8. 8. Total plant weight:

The average total plant weight including stem and root at 45 DAS was recorded

3.9. Yield observations:

3.9.1. No of pods/plant:

Total number of pods was counted and presented as per plant basis.

3.9.2. Total grain weight:

Total grain weight was recorded and presented in tones/ha.

3.9.2.1. Yield gain due to zinc nutrition:

Yield gain due to zinc application under full dose of recommended fertilisers in each of the organic manure was calculated by the following formula. Din *et al.*, (2001).

$$\text{Yield gain} = \frac{\text{Grain yield in 100\% RD NP +Zn} - \text{Grain yield in 100\% RD NP}}{\text{Grain yield in 100\% RD NP}}$$

3.9.2.2. Yield gain due to source of organic matter was calculated as

Under 100%RDNP =

$$\frac{\text{Grain yield in 100\% RD NP} - \text{Grain in yield in respective control plots}}{\text{In respective control plots}}$$

Under 100%RDNP +Zn =

$$\frac{\text{Grain yield in 100\% RD NP +Zn} - \text{Grain in yield in respective control plots}}{\text{In respective control plots}}$$

3.9.3. Straw weight:

Total straw weight was recorded and presented as tones/ha.

3.9.4. Bio mass:

Total grain and straw weight was pooled and presented as tones/ha.

3.9.5 Total Nitrogen in biomass:

Total nitrogen worked out in bio mass and presented percentage and kg/ha.

3.9.6. Total Nitrogen in husk and roots:

Nitrogen content of leaf samples and grain were estimated by Modified microkjeldhal method as described by Piper, 1960 and computed the total nitrogen in husk and roots.

3.9.7. Total Nitrogen and protein in grain:

The grain protein percentage was worked out by multiplying the nitrogen content by 6.25.

The total protein production per hectare was worked out by multiplying the protein percentage with the total grain produced in each treatment

3.9.8. Shelling percentage:

The grain recovery from the total pod weight was calculated and presented as percentage.

3.9.9. Dal percentage:

Dal percentage was worked out by hulling the grain and computed percentage of dal.

3.9.10. Test weight:

Randomly selected 1000 grain weight was recorded and presented.

3.9.11 Grain volume:

The above selected 1000 grain volume was recorded by water displacement technique using measuring cylinder.

3.9.12. Harvest index (Partial):

Partial harvest index is worked out by dividing the total grain with the total biomass under each treatment. (Loc-cit)

$$\text{HI} = \frac{\text{Total weight of grain in the treatment}}{\text{Total biomass produced in the treatment}}$$

3.9.13. Harvest index (Actual):

Actual harvest index is worked out by subtracting the grain produced in the control from the treatment and divided by the biomass produced in the treatment after deducting the biomass in the control.

$$\text{HI} = \frac{\text{Grain weight in the treatment} - \text{Grain weight in control}}{\text{Biomass produced in the treatment} - \text{Biomass produced in control}}$$

3.10. Soil Analysis:

Soil Analysis was done as per the procedures described by Jackson (1973).

3.10.1 pH:

By glass electrode method.

3.10.2 Ec:

Measured using Conductivity bridge.

3.10.3 Organic Carbon (OC):

Estimated by Walkely and Black method (1934).

3.10.4 Available Nitrogen :

Estimated by Alkaline permanganate method as described by Subbaiah and Asija method; (1956).

3.10.5 Available Phosphorus:

Estimated by Olsen *et al.*, (1954).

3.10.6 Available Potassium:

Estimated by Flame photometer method (Jackson, 1973)

3.10.7 Chlorides:

Estimated by titration method as described by Jackson, (1973)

3.10.8 Soil moisture at 40 DAS:

Soil cores from 00-15 and 15-30 cm depth were collected at 7.00 am. Fresh and dry weights were recorded after drying the samples at 105⁰C in the draft air oven.

3.10.9 Soil moisture at 70 DAS:

Soil cores from 00-15 and 15-30 cm depth were collected at 7.00 am .Fresh and dry weights were recorded after drying the samples at 105⁰C in the draft air oven.

3.11. Plant Tissue Analysis:

The fresh samples were dried at 65⁰C and ground in the Willey grinding machine and the powder was used for chemical estimation.

3.12 Use efficiency of the nitrogen nutrient:

The use efficiency was worked out as detailed below (surekha *et al.* (2008).

3.12.1. Agronomic use efficiency of applied nutrients:

Agronomic use efficiency of the applied nutrients was worked out by subtracting the grain of control from the treated plot divided by the quantity of the nutrient applied through manures and fertilisers.

Partial agronomic use efficiency =

$$\frac{\text{Grain yield in treatment} - \text{Grain yield in respective control}}{\text{Quantity of inorganic nitrogen applied in the treatment}}$$

Actual agronomic use efficiency =

$$\frac{\text{Grain yield in treatment} - \text{Grain yield in absolute control}}{\text{Quantity of nitrogen applied in the treatment (Organic + Inorganic)}}$$

3.12.2. Physiological use efficiency of nitrogen applied:

The partial and actual physiological use efficiency of nitrogen was worked out by subtracting the grain yield in control plot from the treated plot divided by the total N uptake in the treated plot after subtracting the total N uptake in the control plot.

Partial physiological Use efficiency =

$$\frac{\text{Grain yield in treatment} - \text{Grain yield in respective control}}{\text{Nitrogen uptake in treatment} - \text{N uptake in respective control}}$$

Actual physiological Use efficiency =

$$\frac{\text{Grain yield in treatment} - \text{Grain yield in absolute control}}{\text{Nitrogen uptake in treatment} - \text{N uptake in absolute control}}$$

3.12.3. Nitrogen uptake efficiency:

The nitrogen recovery efficiency partial and actual is worked out by subtracting the N uptake in control from the N uptake in the treated plot by dividing with the amount of N applied.

Partial N uptake efficiency =

$$\frac{\text{N uptake in treatment} - \text{N uptake in respective control}}{\text{Amount of inorganic N applied}}$$

Actual N efficiency =

$$\frac{\text{N uptake in treatment} - \text{N uptake in absolute control}}{\text{Amount of organic + inorganic N applied}}$$

3.12.4. Nitrogen harvest index, (NHI):

Nitrogen harvest index is calculated by dividing the N uptake in the grain by N uptake by total biomass.

$$\text{NHI} = \frac{\text{N uptake in grain}}{\text{Total N uptake by biomass}}$$

3.12.5. Internal use efficiency of Nitrogen:

The grain yield in the treated plot is divided by N uptake by the grain.

$$\text{Grain / kg N uptake} = \frac{\text{Total grain yield in treatment}}{\text{Total N uptake}}$$

3.12.6. Recovery use efficiency of Nitrogen. (RUE):

$$\text{Partial RUE} = \frac{\text{N uptake in N applied plot} - \text{N uptake in respective control}}{\text{N applied}}$$

$$\text{Actual RUE} = \frac{\text{N uptake in N treated plot} - \text{N uptake in absolute control}}{\text{N applied}}$$

3.13. Statistical Analysis:

The data were subjected to statistical analysis for its significance as described by Snedecor and Cochran (1967).

3.14 Optimum dose of inorganic fertilisers:

The optimum dose of inorganic fertilisers was calculated for all the organic manures applied individually based on the following equation as described by Andre Guinard (1982)

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$$Y = a + b x - c x^2$$

Where Y is yield estimate, X is the quantity of N applied, a is constant and b, c are the coefficients.

For optimum dose of N

$E = 1 - b x / 2c$ where E= is the economic optimum dose of N

$E_n = P R / P N$ where PR is price of crop and P N is the price of N

Price of

N = Rs 26.00 / kg

P₂O₅ = Rs 46.50 /kg

Chick pea = Rs 25.00 / kg grain

3.15. Economics of chickpea cultivation:

Taking into consideration the cost of cultivation and gross income realized under various treatments the economics was calculated and conclusions were drawn.