PRE-DISSERTATION REPORT
(AGR- 591)

Estimation of Nitrogen Use Efficiency and Its Effect on Crop Growth and Yield of Maize (*Zea mays L.*) on Crop Rotation with Different Leguminous Crop

Synopsis Submitted To

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In
Agronomy
By

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CERTIFICATE

I certified that this synopsis **Akash bhargaw** with registration no: 11715298, "**Estimation of Nitrogen Use Efficiency and Its Effect on Crop Growth and Yield of Maize (*Zea mays L* .) on Crop Rotation with Different Leguminous Crop**" has been formulated and finalized by the student on the subject.

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DECLARATION

I hereby declare that the project work entitle " **Estimation of Nitrogen Use Efficiency and Its Effect on Crop Growth and Yield of Maize (*Zea mays L* .) on Crop Rotation with Different Leguminous Crop"** is an authentic record of my work carried out at lovely professional university as requirements of project work for the award of degree of Master of Science in Agronomy, under the guidance of Dr. Priyamvada Chauhan School of Agriculture, Lovely Professional University, Jalandhar, Punjab, India.

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Introduction

Maize has become a staple food in many parts of the world, with total production surpassing that of wheat or rice. However, not all of this maize is consumed directly by humans. Some of the maize production is used for corn ethanol, animal feed and other maize products, such as corn starch and corn syrup. It is an important source of carbohydrate, protein, iron, vitamin B, and minerals.

This month the United States Department of Agriculture (USDA) estimates that the World Corn Production 2017/2018 will be 1031.86 million metric tons, around 1.8 million tons less than the previous month's projection. In India, the production is about 25,000,000 metric tonnes and occupies as eighth position worldwide. In Punjab, The maize production in Punjab in 2012-13 was 4.71 lakh metric tonnes, and the total area under the crop was 1.29 lakh hectares (Department of Food Processing Punjab 2013). With an average productivity of 3,650 kg/ha.

Among several functions, the nitrogen plays a key role on plants metabolism, this element takes part in different metabolic path ways of great importance to plants and participates in the protein synthesis. Most of the cultivated soils allow plants growth without addition of nutrients in mineral form. However, to seek higher production levels, the application of nutrients in mineral form is required, the current recommendation of nitrogen fertilization to define the amount to be applied. More than 95% of the nitrogen in the soil is organic, this organic form is not assimilated by plants, requiring to go through a mineralization process, in other words, the transformation from organic to mineral nitrogen called amination and ammonification.

The identification of the character of highest contribution to maize yield is an important tool which assists identifying the critical period of the crop development, allowing the adoption of management practices in order to optimize the conditions at the moment of the main grain yield component definition. Generally, nitrogen is present in the soil solution on nitrate or ammonium forms, however the plants are physiologically responsive only to nitric nutrition. As the biologically fixed nitrogen has many advantage over organic k nitrogen as it is radially available to the crop plant and nitrogen use efficiency is also improved by biologically fixed nitrogen. On the another hand, it also support agricultural sustainable and reduce the health hazards of human and animals caused by use inorganic fertilizer. There are many ways by which nit SO rogen can be fixed biologically in the soil. One of the most efficient ways for biologically fixation is planting of leguminous crop as they have the mechanism of symbiosis with various *Rizobium spp* with their root nodules.

Rizobium bacteria present in root nodes of legume crop convert atmospheric nitrogen in Ammonium form. This nitrogen is easily absorbed by plant in compare to inorganic fertilizer. So it is profitable to do crop rotation of any crop with legume crop because it fixes nitrogen to soil. and hence save money and is more economic to farmer. And it also reduces dependency on inorganic fertilizer. So with the vied of above importance of biologically fixed nitrogen, the present experiment **"Estimation of Nitrogen Use Efficiency and Its Effect on Crop Growth and Yield of Maize (*Zea mays L.*) on Crop Rotation with Different Leguminous Crop"** Is being conducted with following objectives:

- To estimate the effect of biologically fixed nitrogen on the growth and yield of maize
- To compare the nitrogen use efficiency of maize with the use of available nitrogen in soil which was fixed biologically by different leguminous crops sown in previous season.
- To evaluate the effect of various combinations of different doses of inorganic fertilizers with biologically fixed nitrogen on yield of maize.
- To measure the quality and quantity of protein stored in maize kernels with the use of uptake of nitrogen fixed biologically by different leguminous crops.

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REVIEW OF LITERATURE

Bonsu and Asibuo (2013) conducted an experiment by the Application of inadequate quantities of fertilizers limits maize yield in Ghana. Experiments were conducted to determine the effect of *Mucuna pruriens*, *Canavalia ensiformis,* and soybean (*Glycine max* (L.) Merrill) on maize (*Zea mays* L.) grain yield under 4 mineral fertilizer N levels in a rotational system. The legumes were established in April of 1996 and 1997 at Ejura in the forest-savanna transition zone of Ghana. During August of the respective years, the vegetation on the plots was slashed with a cutlass. Maize was planted in all the plots with blanket P and K application. Fertilizer N was applied as urea at four rates (0, 30, 60 and 90 kg N/ha) to the maize in split applications at 1 and 5 weeks after planting. Mucuna and Canavalia produced more than 3 t/ha of biomass within 4 months. Mean maize grain yields after the legumes without fertilizer N were 2.3, 1.6 and 1.0 t/ha for Mucuna, Canavalia and soybean, respectively. Maize grown after legumes responded to fertilizer N and this is an indication that the legumes didn't supply the entire N required by maize for optimum yield. The highest marginal rates of return of maize grown after canavalia and soybean were at 90 kg N/ha whilst that of mucuna was at 60 kg N/ha. It was concluded that planting Mucuna and maize in rotation is the best among the systems considered in terms of monetary gain and soil organic matter addition and the application of 60 kg N/ha to maize planted after Mucuna was the most efficient management option.

In the northern Guinea Savanna of Ghana a field experiment was conducted to study the reasons for beneficial effects of rotating maize (Zea mays) and cowpea (Vigna unguiculata) on yield and N and P use of maize. The treatments included two cropping systems, maize mono-cropping and maize/cowpea rotation, two levels of nitrogen (0 and 80kg N ha -1 as urea) and two levels of phosphorus application (0 and 60 kg ha- 1 p as Volta phosphate rock). Yields and nutrient accumulation of maize were larger in rotation than in mono-cropping, independent of the N and P level. Fertilizer application (N and P) increased yields of maize in both cropping systems to the same extent. Nitrate contents of the soil after cowpea and after maize monoculture were comparable at the beginning of the cropping period. However, soil nitrate of fertilized plots was similar or even higher under monocropping than under crop rotation, especially in deeper soil layers and at the end of the cropping period. This indicates that in addition to the availability of mineral N, its use by the plants was limiting for the productivity of maize. Root length densities of maize were significant lower in mono-cropped maize than in maize grown in rotation. Also in a pot experiment maize growth was much better in the soil from the crop rotation than from the mono-cropping plots, provided P was eliminated as the main growth-limiting factor. Since this effect persisted in spite of N application and optimization of soil physical properties by mixing the soil with polystyrol it is concluded that the results indicate that yield decline in maize mono-cropping might be due to allelopathic effects **(Horst and Härdter,1984-1987).**

Sabyasachi *et al.* in **2000** conducted an experiment on legumes crops to study the nitrogen fixiation. Nitrous oxide (N2O) emissions were monitored for a period of 60 days in a pot culture study, from two *kharif* (June–September) and two rabi (October–March) season legumes, which were grown on a Typic Ustochrept, alluvial sandy loam soil. Black gram (*Vigna mungo* L. Hepper), var. T-9, and soybean (*Glycine max* L. Merril), var. Punjab 1, were taken up in *kharif* season whereas lentil (*Lens esculenta* Moench), var. JLS-1, and Bengal gram (*Cicer arietinum* L.), var. BGD-86, were grown in *rabi* season. All the crops were grown with and without urea and one pot (containing soil but with no fertilizer or crop) was used as a control. Nitrous oxide emissions were significantly higher in unfertilized cropped soil than in the control, while the addition of urea to the crops further increased the emissions. Significant emissions occurred during third and seventh week after sowing for all the treatments in both kharif and rabi seasons. In kharif, soil cropped with soybean had higher total N2O-N emission than soil sown with black gram both under fertilized and unfertilized conditions; while in rabi, lentil had a higher total N2O-N emission than Bengal gram under both fertilized and unfertilized conditions. In *kharif,* total N2O-N emissions ranged from 0.53 (control) to 3.84 kg ha–1 (soybean+urea), while in rabi it ranged from 0.45 (control) to 3.06 kg ha–1 (lentil+urea). Higher N2O-N emissions in *kharif* than in *rabi* was probably due to the favourable effect of temperature on nitrification and denitrification in the former season. The results of the study indicated that legume crops may lead to an increase in N2O.

Arif M. *et al.* (2006) have conducted experiment to study the impact of plant population and nitrogen levels on maize, an experiment was conducted at KPK Agricultural University, Peshawar, Pakistan during summer The experiment was carried out in randomized complete block (RCB) design with split plot arrangement having four replications. Plant populations (4, 6 and 8 plants m-2) were kept in the main plots while nitrogen levels (0, 100, 130 and 160 kg ha-1) were allotted to the subplots. The size of each subplot was 3 m × 5 m (15m2) with row to row distance of 75cm. Azam variety was sown at the seed rate of 40 kg ha-

1. The required plant population i.e., 4, 6 and 8 plants m-2 were maintained by thinning after emergence. Ears m-2, grain yield and biological yield consistently increased with increase in plant density from 4 to 8 plants m-2. However, grains ear-1 and thousand grain weight lessened with increase in plant density. Harvest index declined with increase in plant density but harvest index of plant densities of 4 and 6 plants m2was statistically at par with each other. Ears m-2, grains ear-1, thousand grain weight, grain yield, biological yield and harvest index constantly improved with increasing level of N. Likewise, ears m-2, grains ear-1, thousand grain weight, grain yield, biological yield and harvest index were higher at the highest level of N. The plant density × nitrogen interactions for ears m-2, grains ear-1 and grain yield were significant. Ears m-2, grains ear-1 and grain yield continually enhanced with increase in N level from 0 to 160 kg ha-1at all plant densities. It was concluded that the highest plant population of 8 plants m -2and the highest N level of 160 kg ha-1.

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Materials and methods

Experimental materials

The material for the present investigation is comprised of varieties of three leguminous crops viz., gram, pea and lentil, respectively using for biological nitrogen fixation in previous season and one variety of maize. The varietal details of the experimental material are as follows:

Table: Varietal details of the experiment:

S.No.	Name of crop	Name of variety	Source
1.	Gram	PBG5	PAU, Ludhiana
2.	Pea	AP3	PAU, Ludhiana
3.	Lentil	LL931	PAU, Ludhiana
4.	Maize	DHM-103	DMR, Delhi

Methods

Experimental site

The present experiment will be conducted in *rabi*, 2017 and *kharif*, 2018 at agricultural farm of Lovely Professional University, Jalandhar, Punjab which is located between 31° 19' N and 35° 18' E in Punjab state in India at about 252meters above from sea level and this region falls under Trans-Gangetic plain region of agro climatic zone.

Experimental design

The experiment will be carried out in Randomized Complete Block Design (RCBD) in three replications and will be comprised of three treatments with control in *Rabi*, 2017. Details of treatments is given as below:

S. No.	Treatments	Detail of treatment
1.	T0	Control
2.	T1	Pea
3.	T2	Gram
4.	T3	Lentil

Layout of experiment **29m**

Irrigation channel (1 m wider)				
T1	Irrigation channel (1m wider)	T2	Irrigation channel (1 m wider)	T3
T0		T3		T1
T3		T0		T2
T2		T1		T0

32m

Observations to be recorded:

1. Field emergence per cent
2. Plant height (cm)
3. Days to 50 per cent flowering
4. Leaf length
5. Leaf width
6. Flag leaf length
7. Flag leaf width
8. Stem girth
9. Cob length
10. Cob width
11. Cob yield per plant
12. Yield per plot
13. 100 seed weight

Statistical Analysis

Recorded data for various parameter of maize crop sowen in kharif 2018 will be anaylised in three factor anaylises with the help of OP-STAT Softwere developed by HAU, Hisar.

REFERENCES

1. **Arif, M., Jan, M.T., Khan, N.U., Akbar, H., Khan, S. A., Khan, M.J., and Iqbal, A.** impact of plant populations and nitrogen levels on maize. *Pak. J. Bot*., **42(6):** 3907-3913.
2. **Ghosh, S., Majumdar, D. and Jain, M. 2002**. Nitrous Oxide Emissions from K*harif* and *Rabi* Legumes Grown on an Alluvial Soil. *Biol Fertil Soils.* **35:**73–478.
3. **Barraclough, P. B. 1989.** Root growth, macro-nutrient uptake dynamics and soil fertility requirements of a high-yielding winter oil-seed rape crop. *Plant and Soil*. **119:** 59–70.
4. **Böhm, W. 1979.** Methods of studying Root Systems. Springer Verlag, Berlin. Springer-verlag, berlin-heidelberg-new york. ISBN 3-540-09329-X, 188 s., 69 abb., leinen dm 69.
5. **Bowen, W. T., Quintana, J. O., Pereira, J., Bouldin, D. R., Reid, W. S. and Lathwell, D. J. 1988.** Screening legume green manures as nitrogen sources to succeeding non-legume crops. *Plant and Soil*. **111:** 75–80.
6. **Breakwell, D. P. and Turco, R. F. 1989.** Nutrient and phytotoxic contributions of residue to soil in no-till continuous-corn ecosystems. *Biol. Fertil. Soils*. **8:** 328–334.
7. **Sithole, N. J. and Thibaud, G.R. 2017.** Long-term impact of no-till conservation agriculture on abundance and orderdiversity of soil macrofauna in continuous maize monocropping system. *Acta Agriculturae Scandinavica, Section B — Soil & Plant Science* 2017.