LOVELY PROFESSIONAL UNIVERSITY

School of Agriculture

Synopsis of Thesis/ Dissertation-I Project Report of Post- Graduate Student

M.Sc. (Agri)

TITLE OF THE RESEARCH WORK:

Dynamics of Soil Physical and Chemical Properties under different Fertilizer levels in maize *(Zea mays L.)*

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CERTIFICATE

I certified that this synopsis **Khaidem Jackson** bearing registration no. 11713598 has been formulated and finalized by the student on the subject **'Dynamics of Soil Physical and Chemical Properties under different Fertilizer levels in maize *(Zea mays L.)'***

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DECLARATION

I hereby declare that the project work entitiled **"Dynamics of Soil Physical and Chemical Properties under different Fertilizer levels in maize *(Zea mays L.)*''** is an authentic record of my work carried out by Lovely Professional University as requirement of project work for the award of degree of Master of Science in Agronomy, under the guidance of Er. Nitin Madan Changade, Department of Soils, School of Agriculture, Lovely Professional University, Phagwara, Punjab.

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Introduction

Maize can be defined as 'the king of cereals' due to its productivity potential as compared to other cereals (*Roychoudhury et al., 2017*). It is the third most important crop in India after wheat and rice. Maize is a traditionally consumed staple food for household consumption. However, there has been increased demand for animal feeds and industrial utilization over the recent years. In India, the amount of maize being used for animal feed is nearly 50% (*Singh et al., 2003*). The contemporary cultivation of maize in India is distributed over 8.33 million ha of land with average annual productivity of 2002 kg ha $^{-1}$. The contribution of Karnataka in maize production is the foremost with an annual production of 3.03 million tonnes from an area of 1.07 million ha (*Ravi et al., 2012*). The sharp spike has been seen in the import and utilization of maize in Southeast Asia over the past decade. It describes the importance of maize cultivation both for domestic as well as export purpose. The productivity of maize relies on the proper nutrient management as maize requires high nourishment for their growth and development. Utilization of chemical fertilizers cannot be completely removed as they provide the necessary plant nutrients in easily available forms. But usage of chemical fertilizers continuously is a detrimental factor for soil health. The combined application of organic and chemical fertilizers can help in providing appropriate sustainable level of plant growth and yield (*Obi and Ebo., 1995*).Maize is a C4 plant and hence has immense production potential *(Jain et.al.,1981).* It is a staple food of many parts of the world. Maize is grown for different purposes such as grain, baby corn, sweet corn, pop-corn, corn flour, corn starch, corn syrup, animal feed and fodder etc. It can be used as an animal feed at any stage with no problem of poisoning and hence it is also called 'King of Fodder'*(Shinde et.al.,2014).*

Maize ranks first among cereals with average yield around 2.5 tonnes per hectare. Currently it is cultivated over 8.67 million hectare with 21.6 million tonnes production, having an average productivity of 2,435 kg/ha which contributes to nearly 8% in the national food basket*(Kumar et.al.,2015).*In terms of world area, India stands next to USA, Brazil, China and Mexico, whereas in production it ranks eleventh. It can be grown in any season throughout the year as it has photo-thermo insensitive character. Maize (Z*ea mays* L.) is an ideal crop owing to its quick

growing habit, high yielding ability, palatability and nutritious ness. It is rich in phosphorous, magnesium, manganese, zinc, folic acid, copper, iron and vitamin A, B and C, and may have small amounts of potassium and calcium *(Shinde et.al.,2014).*

In India, presence of weeds reduce the maize yields by 27-60%, depending upon the growth and persistence of weed population *(Kumar et.al., 2015).* This can be manipulated through the adoption of moisture conservation techniques like mulching and nutrient management. Water scarcity is one of the major problem in agriculture. New challenges have been created with the increase in population, decrease in soil quality and change in the environment .The availability of irrigation water is predicted to be cut off by 25% by 2010 and 31-33% by 2025 (State of *Environment Report 2005; Rana 2013)* which is assumed to affect the crop production. These problems can be tackled by using effective and efficient use of moisture conservation techniques. The Extension Department of Colorado State University stated that mulches can cut off water use by 25-50% on soil surface. *Muhammad et. al.,2002* stated that mulching improves soil moisture status and structure of the soil. Mulching is a protective cover or layer of material applied to the soil surface. It is usually made up of organic matter such as leaves, straw, peat or sometimes done with plastic to prevent evaporation which aids in moisture conservation, reduce growth of weed and enhance health and fertility of the soil. It reduces the deterioration of soil, minimizes weed infestation and checks the water evaporation thus enhancing retention of soil moisture that helps in control of temperature fluctuations, improves physical, chemical and biological properties of soil which ultimately enhances the growth and yield of crop. It was reported that crops planted with mulching gave increased yield by 50-60% over control *(Shirish et.al. 2013).*

Crop nutrition is an important aspect to achieve improved growth and higher yield. For increasing the profitability and productivity of maize in economic view, we can cultivate the crop intensively through the utilization of organic and inorganic fertilizers. Maize is an exhaustive crop and requires heavy application of nitrogen along with phosphorous and potassium. It responds well to fertilizers and a crop producing 6.27 t/ha grain yield requires 168 kg N, 57 kg P_2O_5, 135 kg K_2O and 30 kg Zn/ha *(FAI, 2006).* The response of maize to different fertilizer application varies from variety to variety, location to location and also depends on the availability of the nutrients (Onasanya *et al*., 2009).

Application these fertilizers above or below the optimum level affects the crop growth and yield of the crop adversely.

Nitrogen is a vital plant nutrient and a major yield determining factor required for maize production. An adequate supply of N is associated with dark green colour, high photosynthetic activity and vigorous growth (Mengel *et al*., 2001 and Onasanya *et.al*., 2009). When N supply is adequate and the conditions are favorable for growth, proteins are formed from manufactured carbohydrates (Olsthoorn *et al*., 1991).

Phosphorus is essential for cell division as it is a constituent element of nucleoprotein which is involved in the cell reproduction processes. It is important for seed and fruit formation and crop maturation. Phosphorus hastens the ripening of fruits thus counteracting the effect of excess nitrogen application to the soil. It helps to strengthen the skeletal structure of the plant thereby preventing lodging and also affects the quality of the grains. However, the requirement and utilization of these nutrients (nitrogen and phosphorus) in maize depends on environmental factors like rainfall, varieties and expected yield (Onasanya *et al*., 2009).

Potassium is an essential macro-element required in large amounts for normal plant growth and development. It increases the photosynthetic rates of crop leaves, CO_2 assimilation and facilitates carbon movement even at high soil moisture conditions (Sangakkara *et al*., 2000). It helps in the translocation of photosynthates from sources to sinks (Cakmak *et al*., 1994) and activates enzymes for resistance to plants against fungal and bacterial diseases (Sanghera., 2009).

Use of inorganic fertilizers excessively or inefficiently had not only reduced the soil the soil quality and health but also lowers the productivity of the land in the long run. The use of organic materials as a manure combined with inorganic fertilizers will help improve physical and biological properties of soil and will reduce the problems brought about by synthetic fertilizers.*(Namazi et. al.,2015)* Many organic fertilizers are available commercially in the market, eg., vermicompost, compost, peat,perlite, farm yard manure, poultry litter, etc. These type of organic fertilizers can be produced at small scales also with proper materials. In this study, we aim to find out the best combination of organic and inorganic fertilizers along with two moisture conservation techniques i.e plastic mulch and straw mulch.

The present study conducted on kharif maize was done with the purpose of achieving the following objectives:

1. To study the effect of dynamic soil physical and chemical properties under maize cultivation
2. To study the response of fertilizer on different growth attribute of the plants
3. To understand and correlate the utilization of different fertilizers for maize cultivation.

Review of Literature:

FERTILIZER APPLICATIONS:

Garg et al., 2007 studied the phosphorus availability to maize as influenced by organic manure and fertilizer P associated phosphatase activity in soils. Laboratory incubation and green house studies were conducted to compare the P availability of organic manures and P uptake from organic manures by maize. Total P uptake by maize increased with the increasing level of inorganic P in both soils. The highest uptake was obtained in poultry manure treated soil and lowest in the crop residue amended soil.

Rudrappa et al., 2005 studied long- term manuring and fertilization effects on soil organic carbon pools in a Typic Haplustept of semi-arid sub-tropical India. The result showed that microbial metabolic quotient (qCO2) was significantly lower in 100% NPK + FYM over other treatments to indicate this to be the most efficient manuring practice to preserve organic carbon in soil where it facilitates aggradations of more recalcitrant organic carbon in the soil.

Virk et al., 2005 studied increasing the client orientation of maize breeding using farmer participation in eastern India. A maize-breeding programme was targeted at resource-poor farmers of eastern India using a client-oriented approach. The returns were higher from this highly client-oriented approach, than by classical breeding, mainly because uptake was faster as a result of research and extension being done in tandem.

Biswas et al., 1996 studied sustainable yield trends of irrigated maize and wheat in a long- term experiment on a loamy sand in semi-arid India. It was concluded that the high level of crop production can be sustained with the application of N, P and K under intensive cropping system provided deficiency of any of the micronutrient does not crop up.

Setiyono et al., 2010 studied Estimating maize nutrient uptake requirements. The study suggested the relationship between N uptake and actual yield is affected by both yield potential and efficiency in biomass partitioning.

Carlos et al., 2008 studied vermicompost leachate as liquid fertilizer for maize forage production. The result obtained showed that vermicompost leachate diluted with 50% and mixed with 170 gL -1 NPK resulted in the best maize development.

Roychowdhury et al., 2017 studied the effect of biofertilizers and the effect of vermicompost on the cultivation and productivity of maize. The result showed that the application of biofertilizers and the application of vermicompost can both increase the yield of maize and all the other component of maize plants like cob weight, leave production height weight.

Ravi et al., 2012 studied the effect of integrated nutrient management on growth and yield of quality protein maize. A field experiment was conducted with 12 replications and applications of organic and different amount of chemical fertilizers. The results yielded that the application of 75% of the RDF along with organic fertilizers provided the best results.

SOIL PROPERTIES:

Rasool et al., 2007 studied the soil physical fertility and crop performance as affected by the long term application of FYM and inorganic fertilizers in rice-wheat system. The aim of the study was to characterize the physical treatments of the soil in rice and wheat crops with the utilization of FYM and NPK at different amounts. The results yielded that the grain yield and uptake of NPK in both crops were higher with the applications of both NPK and FYM.

Saha et al., 2008 studied the influence of continuous application of inorganic nutrients to a Maize-Wheat rotation on soil enzyme activity and grain quality in the rainfed Indian soil. The study showed that the grain protein content of both maize and wheat were high in mineral fertilized plots. The test weight also increased significantly with the application of mineral fertilizers.

Chakraborty et al., 2010 studied the soil physical quality as influenced by long term application of fertilizers and manure under maize-wheat system. The studied showed that the field capacity, moisture content, plant available water content and saturated hydraulic conductivity were generally higher in manure plots. Close associations of S with soil physical parameters was obtained, indicating potential of S in quantifying the modifications of soil physical environment through fertilizer and manure applications.

Anupama et al., 2005 studied the technical efficiency in maize production in Madhya Pradesh: estimation and implications. The study showed that the majority of farmers in the state cultivate improved cultivars of maize without implementing modern technology of farming. There was significant changes in the yield when compare to the traditional maize cultivars and the cost of production is also lower.

AGRICULTURAL PROFILE:

***Study area*:**

The study was carried out at the official field of Lovely Professional University, Kapurthala, Punjab, India. Six agro climatic zones have been classified to characterized climatic zone distribution in Punjab and the study area in Chaheru village of Kapurthala district, which lies the heart of northern plain zones. Out of the six agro climatic zone of Punjab, the area lies in Central Plain region.

The Kapurthala district lie between the $30^0$39' N latitude and $75^0$55' E longitude. The total geographical area is about 4000 km^2 (CGWB, 2007a; CGWB, 2008a). The study area lies in the Beat Doab tract, an inter-alluvial plain between Beas and Sutlej River.

Climate:

The climatic condition of the study area could be classified under tropical and dry sub humid. An annual precipitation of 779 mm occurs in Kapurthala district with 70% of rainfall occurring during southwest monsoon (CGWB, 2007a; CGWB, 2008a).

MATERIAL AND METHODS:

A field experiment on 'Dynamics of soil physical and chemical properties under different fertilizer levels in maize (Zea mays L.) will be conducted during *kharif* season 2018 at agricultural farm of Lovely Professional University located in the village Hardaspur of Kapurthala District under open condition. The details of the material and methods and the experimental techniques which are to be followed during the course of investigation are presented below.

Treatment Details:

T0: CONTROL

T1: 100% RDF

T2: 75% RDF

T3: 50% RDF

T4: 5 tonnes/ha VERMICOMPOST

T5: 5 tonnes/ha VERMICOMPOST + 50% RDF

T6: 2.5 tonnes/ha VERMICOMPOST + 75% RDF

DESIGN AND LAYOUT:

The experiment will be laid out in a Randomized Complete Block Design (RCBD) with three replications. The gross plot size was 6.0m x 3.0m with net plot of 5.6m x 2.6m

Experimental details:

1. Year of experimentation: 2018
2. No. of treatments : 7
3. No. of replications : 3
4. Total no. of plots : 21
5. Plot size : 6.0m x 3.0m
6. Date of sowing : second week of June
7. Experimental design : Randomized Complete Block Design (RCBD)
8. Crop and Variety : Maize and PMH-1
9. Plant to plant distance : 20cm.
10. Row to row distance : 60cm.
11. Estimated area needed : 500 sq. m

Analytical methods to be followed:

Serial no.	Test parameters	Methods	References
Soil parameters			
1.	pH(1:2.5)	Glass electrode	Sparks (1996)
2.	E.C(1:2.5)	Conductivity meter	Sparks(1996)
3.	Organic Carbon	Wet digestion	Walkley and Black (1934)
4.	Available Nitrogen(N)	Alkaline & potassium permanganate method	Subbiah and Asija (1956)
5.	Available Phosphorus	Olsen method depending upon pH	Olsen et al., 1954
6.	Available Potassium 6.	Flame photometer	Jackson (1973)

OBSERVATIONS TO BE RECORDED:

A periodical observation will be undertaken during the experiment for the following parameters DAS and at the time of harvesting for the maize crop.

A) Growth Parameter		
	Plant population	20 days interval
	Plant height	
	No of leaves	
	Stem girth	
	Leaf area index	
	Plant fresh weight	At time of harvest
	Dry matter production	
B) Yield parameter		
	No. of cobs per plant	At time of harvest
	No. of seed per plant	
	Plant yield	
	Harvest index	After harvest
	Seed index	
	Protein content	
Soil analysis		
C) Soil physical properties		
	Bulk density	Stages of crop growth
	Particle density	
	Soil texture	
	Water holding capacity	
D) Soil chemical properties		
	Ph	Before and after harvest Stages of crop growth
	EC	
	Organic carbon (%)	
	Available N	
	Available P	

	Available K	
	CEC	

EXPECTED OUTCOMES:

According to the treatments provided, certain outcomes can be predicted. The soil aggregates can be tremendously affected due to application of fertilizer. Along with this establishment, the organic carbon content as well a water holding capacity may as well be increased by the balanced application of fertilizers. The uptake efficiency of NPK fertilizers could also be improved. The soil physico-chemical could be upgraded with the addition of biological fertilizers. The nutrient storage pools can be enlarged as well.

REFERENCES:

Anupama, J., Singh, R.P., Kumar, R., 2005. Technical Efficiency in Maize Production in Madhya Pradesh: Estimation and Implications. Agricultural Economics Research Review Vol. 18 July-December 2005 pp 305-315

Biswas, C.R., Benbi, D.K., 2006. Sustainable yield trends of irrigated maize and wheat in a long term experiment on a loamy sand in semi-arid India. *Nutrient Recycling in Agroecosystems* 46, 225-234.

Carlos, G.G.R., Dendooven, L., Antonio, G.M.F., 2008. Vermicomposting Leachate (Worm Tea) as Liquid Fertilizer for Maize (*Zea mays* L.) Forage Production. Asian Journal of Plant
Sciences Volume 7 (4): 360-367, 2008.

Cakmak, I., Hengeler, C., Marschner, H., 1994. Partitioning of shoot and dry matter and carbohydrates in bean plants suffering from phosphorus, potassium and magnesium deficiency. J. Exp. Bot,45(9), 1245-1250

Chakraborty, D., Garg, R.N., Tomar, R.K., Dwivedi, B.S., Aggarwal, P., Singh, R., Behera, U.K., Thangasamy, A., Singh, D., 2010. Soil Physical Quality as Influenced by Long-Term Application of Fertilizers and Manure Under Maize-Wheat System. Soil Science: March 2010 - Volume 175 - Issue 3 - p 128-136

CGWB., Ground Water Scenario of Jalandhar District, Punjab. Central Ground Water Board North Western Region, Chandigarh, 2007a, pp- 15.

CGWB., Groundwater Information Booklet Kapurthala District Punjab. Central Ground Water Board North Western Region, Chandigarh, 2007b, pp- 20.

Namazi, E., Shahram L., Ebrahim, F. N., 2015. Effect of vermicompost and chemical nitrogen fertilizer on the various functioning of maize seeds. *Journal of Experimental Biology and Agricultural Sciences.* ISSN No:2320-8694

FAI. Fertilizer Association of India, Fertilizer Statistics, New Delhi, 232-264,2006

Garg, S., Bahl, G.S., 2008. Phosphorus availability to maize as influenced by organic manures and fertilizer P associated phosphatase activity in soils. Bioresour Technol. 2008 Sep; 99(13):5773-7

Jain, G.L.; Jangri, R.P.; Manohar, R.S. and O.P. Jain. 1981. Agronomic advances in maize research. Indian soc. Agron. N7 symp., 196-201

Kumar A., K.S. Rana, D.S. Rana, R.S.Bana, Anil K. C., Vijay P., 2015. Effect of nutrient and moisture-management practices on crop productivity, water-use efficiency and energy dynamics in rainfed maize *(Zea mays L.)* + Soyabean *(Glycine max)* intercropping system.*Indian Journal of Agronomy* 60(1): 150-156.

Mengel, K., Kirkley, E.A., Kosegarten,H., Appel, T. 2001. Principles of Plant Nutrition (5 ed). New Delhi India:Springer.

Muhammad A.S.,, Nadeem A, Javed, H.F.R., Muhammad A.S., Azhar M., Hafig T.A., 2013. Response of zero tilled wheat crop to different mulching technique in a semi-arid environment. *Internal Journal of Advanced Research*. 1(9): 768-776.

Obi, M.E. and Ebo, P.O., 1995. The effect of organic and inorganic amendments of the soil

Olsthoorn, A. F. M., Keltjens, W. G., Van Baren, B. & Hopman, M. C. G. (1991). Influence of ammonium on fine root development and rhizosphere pH of Douglas-fir seedlings in sand. Plant Soil, 133, 75-8 I

Onasanya, R., Aiyelari, O., Onasanya, A., Oikeh, S., Nwilene, F. and Oyelakin, O. 2009. Growth and yield of response of maize*(Zea mays L.)* to different rates of N and P fertilizers is Southern Nigeria. *World Journal of Agricultural Science*, 5(4):400-408

Rana, I. 2013. Water shortage in Pakistan will increase to 31% of people's needs by 2025 and this underlines the need for some tangible steps, including water usage charges and building of storages, to cope with the problem. The express Tribune, Saturday, April 26, 2014.

Rasool, R., Kukal, S.S., Hira, G.S., 2007. Soil physical fertility and crop performance as affected by long term application of FYM and inorganic fertilizers in rice–wheat system. Soil and Tillage Research 96(1):64-72 · October 2007.

Ravi, N., Basavarajappa, R., Chandrashekhar, C.P., Harlapur, S.I., Hosmani, M.H., Manjunatha, M.V., 2012. Effect of integrated nutrient management on growth and yield of quality protein maize. Karnataka J. Agric. Sci.,25 (3) : (395-396) 2012.

Roychowdhury D, Mondal S, Banerjee S.K., 2017. The Effect of Biofertilizers and the Effect of Vermicompost on the Cultivation and Productivity of Maize - A Review. Adv Crop Sci Tech 5: 261. Soil and Tillage Research 88 (1-2): 180-192.

Saha, S., Gopinath, K.A., Mina, B.L., Gupta, N.K., 2008. Influence of continuous application of inorganic nutrients to a Maize–Wheat rotation on soil enzyme activity and grain quality in a rainfed Indian soil. European Journal of Soil Biology 44(5-6):521-531 · September 2008.

Setiyono., T.D., Walters., D.T., Cassman, K.G., Witt, C., Dobermann, A., 2010. Estimating maize nutrient uptake requirements. Field Crops Research Volume 118, Issue 2, 8 August 2010, Pages 158-168

Shinde,S.A., Patange, M.J., Dhage, S.J., 2014. Influence of irrigation schedules and Integrated Nutrient Management on growth, yield and quality of Rabi maize*(Zea mays L.) International Journal of Current Microbiology and Applied Sciences.* 3(12):828-832.

Sanghera, G. S., Gill, M.S., Gosal, S.S., Wani, S.H., 2009. RNA Interference: Its Concept and application in crop plants. In: Biotechnology: Cracking new pastures. Malik C. P. MD Publications, New Delhi, India. p.33-7

Shirish P.S.,Tushar, K., S., Satish., B. A.Mulching: A soil and water conservation Practice. *Research Journal of Agricultural and Forestry Sciences*. 1(3):26-29.

Singh, R.P., Kumar R. and Singh, N.P. 2003. Transformation of Indian maize economy-Different prospective in maize production in India-golden grain in transition, [Eds: R. Kumar and N.P.Singh]. Technical Bulletin TB-ICN: 4/ 2003, Division of Agricultural Economics, Indian Agriculture Research Institute, New Delhi. 1-28

State of the Environment Report Draft. 2005. Ministry of Environment, Government of Pakistan.

Virk, D.S., Chakraborty, M., Ghosh, J., Prasad, S.C., 2005. Increasing the client orientation of maize breeding using farmer participation in eastern India. Exp. Agric. 41: 413-426.