"EFFECT OF MICA MINERAL ON AVAILABLE POTASSIUM IN SOIL AND YIELD OF POTATO"

By

Miss. Devadhe Kavita Babasaheb
(Reg. No. R/ 013/054)

A thesis submitted to the

**MAHATMA PHULE KRISHI VIDYAPEETH,
RAHURI - 413 722, DIST.AHMEDNAGAR,
MAHARSHTRA, INDIA**

in the partial fulfilment of the requirements of degree

of

MASTER OF SCIENCE IN (AGRICULTURE)

in

SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

**DEPARTMENT OF SOIL SCIENCE AND AGRICULTURAL CHEMISTRY,
POST GRADUATE INSTITUTE,
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2015

CANDIDATE'S DECLARATION

I hereby declare that this thesis or part

There of has not been submitted

by me or other person to any

other University or Institute

for a Degree or

Diploma

Place: MPKV., Rahuri **(K. B. Devadhe)**

Date: / /2015

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This is to certify that the thesis entitled**, "EFFECT OF MICA MINERAL ON AVAILABLE POTASSIUM IN SOIL AND YIELD OF POTATO**" submitted to The Faculty of Agriculture, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar in partial fulfilment of the requirements for the degree of **MASTER OF SCIENCE (AGRICULTURE)** in **SOIL SCIENCE AND AGRICULTURAL CHEMISTRY**, embodies the results of piece of bonafide research work carried out by **MISS. Devadhe Kavita Babasaheb,** under my guidance and supervision and that no part of the thesis has been submitted for any other degree or diploma.

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CERTIFICATE

This is to certify that the thesis entitled, "**EFFECT OF MICA MINERAL ON AVAILABLE POTASSIUM IN SOIL AND YIELD OF POTATO",** submitted to the Faculty of Agriculture, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar in partial fulfilment of the requirements for the degree of **MASTER OF SCIENCE (AGRICULTURE)** in **SOIL SCIENCE AND AGRICULTURAL CHEMISTRY**, embodies the results of piece of *bonafide* research work carried out by **MISS. DEVADHE KAVITA BABASAHEB,** under the guidance and supervision of **Dr. S.R. Patil,** and that no part of the thesis has been submitted for any other university for degree or diploma.

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Date : / /2015.

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Place : MPKV., Rahuri.
Date : / /2015. **(K.B. Devadhe)**

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LIST OF ABBREVIATIONS

%	:	Per cent
$CaCO_3$	:	Calcium carbonate
Ca	:	Calcium
cm	:	Centimeter
dSm^{-1}	:	Decicimal per meter
EC	:	Electrical conductivity
et al.	*:*	*Et alia,* and others
Fe	:	Iron
Fig.	:	Figure
FYM	:	Farm yard manure
ha	:	Hectare
i.e.	:	*Id est,* that is
K	:	Potassium
kg ha^{-1}	:	Kilogram per hectare
m	:	Meter
Mg	:	Magnesium
mg g^{-1}	:	Milligram per gram
tha^{-1}	:	Tonne per hectare
cm	:	Centimeter
N	:	Nitrogen
O.C	:	Organic carbon
P	:	Phosphorus
pH	:	*Puissance de hydrogen*
RDF	:	Recommended dose of fertilizers
S	:	Sulphur
viz.,	:	*Vide licet*, namely
Zn	:	Zinc
RP	:	Rock Phosphate
MOP	:	Muriate of potash
NOP	:	Nitrate of potash
SOP	:	Sulphate of potash

ABSTRACT

"EFFECT OF MICA MINERAL ON AVAILABLE POTASSIUM IN SOIL AND YIELD OF POTATO"

By

MISS. DEVADHE KAVITA BABASAHEB

A candidate for the degree

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2015

Research Guide : Dr. S.R. Patil

Department : Soil Science and Agricultural Chemistry

India is the 3rd largest consumer of chemical fertilizers, which are imported and having high cost. India is fortunate to have the world's largest deposit of muscovite mica. Raw material of muscovite mica is in very low cost compared to muriate of potash. It is possible to use mica as a source of potassium instead of potash fertilizers. It gives more yield than muriate of potash, thus it is economically beneficial to farmers.

The present investigation entitled "effect of mica mineral on available potassium in the soil and yield of potato" was carried out at Post Graduate Institute Farm in Inceptisol, Department of Soil Science and Agricultural Chemistry, M.P.K.V, Rahuri during the *Rabi* 2013-14 so as to ascertain the possibility of replacing muriate of potash by use of mica as source of potassium and to study their effect on potato yield, quality and soil available potassium. It was laid out in Randomized Block

Design with three replications. There were five levels of mica mineral.

(100%, 75%, 50%, 25%, 0% with recommended N, P and 20t ha^{-1} FYM combination)

The chlorophyll content increased significantly due to application of 75% K_2O through mica *i.e* 900 kg ha^{-1} with recommended dose of $N:P_2O_5$ (150:60 kg ha^{-1}) and 20 t ha^{-1} FYM. The higher mean number of tubers (11.67) per plant was recorded in treatment T_8 due to application of 75% K_2O through mica *i.e* 900 kg ha^{-1} with recommended dose of $N:P_2O_5$ (150:60 kg ha^{-1}) and 20 t ha^{-1} FYM.

The total uptake of N, P, K and yield of potato increased significantly due to application of 75% K_2O through mica *i.e* 900 kg ha^{-1} with recommended dose of $N:P_2O_5$ (150:60 kg ha^{-1}) and 20 t ha^{-1} FYM.

The treatment T_8 (N: P_2O_5 as per RDF + 75% K_2O through mica + 20 t ha^{-1} FYM) was significantly superior over all treatments in starch content (12.21%) of potato tuber at harvesting stage.

The non significant effect of use of mica application to potato on pH and EC of soil and on organic carbon and calcium carbonate after harvest of crop were recorded. However, the available nitrogen, phosphorus, potassium content of soil after harvested of crop were found as higher as the level of mica application increased.

In conclusion, based on these studied, the application of 75% K_2O (900 kg ha^{-1}) through mica with recommended dose

Abstract contd... **Miss. K.B. Devadhe**

of N (150 kg ha^{-1}), P_2O_5 (60 kg ha^{-1}) and 20 t ha^{-1} FYM was found to significantly increase the chlorophyll content (0.94 mg g^{-1}) in leaves, number of tubers per plant (11.67), potato tuber yield (18.93 t ha^{-1}), total potassium uptake (K-103.86 kg ha^{-1}), available potassium in soil (582.40 kg ha^{-1}) and starch content (12.21%) in potato.

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1. INTRODUCTION

Tuber crops are the 3rd most important food crops of man after cereals and grain legumes. They constitute either staple or important subsidiary food for about a one fifth of the people of the world. They have a higher biological efficiency as food product and show the highest rate of dry matter production per day per unit area among all the crops. They constitute important and cheap source of food and energy especially for the weaker section of people.

The potato (*Solanumtuberosum*) originates from the South America, most likely from the Central Andes in Peru, introduced into Europe in the sixteenth century. The crop subsequently was distributed throughout the world, including Asia. It was grown in India as early as 1615.

The potato is staple food crops of the world(Anon., 1991).Itoccupies 6th position in the world, with the world average being 15.3 tha^{-1}. It is the thirdhighest yielding crop on the basis of fresh matter, after sugarcane and sugar beet. Among the major potato growing countries of the world, China ranks first in area, followed by the Russian Federation, Ukarine and Poland. India ranks fifth in area in the world and cultivated area was 20.32 lakh ha in 2013-14 with production46.61 million MT (Anon., 2013).

Potato as a vegetable has a great importance in our daily diet. Potato is one of the richest sources of calories needed to maintain day to day output of human energy. It provides essential body building substances such as carbohydrate, protein, fats, vitamin A,vitamin B and rich source of vitamin C.It also contains a good amount of essential amino acids like *leucine*, *tryptophan*and *isolucine*(Khurana and Naik, 2003).Potato is a valuable food for those who seek to lower their blood process(Rashid,1993). It is also used in many industries for starchand alcohol production (Abdel *et al.*, 1977).

According to the farmers, advantages of potato cultivation are potential for high productivity, extremely profitable and easily marketed and its price is relatively stable. Potato can be grown even under rainfed conditions in certain parts of the country, it responds well to heavy dose of fertilizer and other forms of inputs resulting in high yields and thereby increasing the income of the potato growers with use of right varieties, right seed and recommended dose of fertilizers, coupled with proper irrigation. Potato is one of the principal cash crops. It contributes to Indian economy in several, ways. On an average it gives a net profit of about Rs. 5,000-8,000 ha^{-1}.

The potassium content of Indian soils generally varies from 0.5 to 3.0 % (Tandon and Sekhon,1998). Uptake of potash in potato crop is 6.2 kg $tonnes^{-1}$ (Ahmad *et al.*, 2009). Singh *et al.*(1996) reported the highest tuber dry matter production (19.05%) and total K uptake (170kg ha^{-1}) in potato with the application of K as muriate of potash (MOP).The tubers at harvest accumulate about 78% of total K.

Along with nitrogen and phosphorus, potassium is one of the essential macronutrient and required by plants in relatively large amounts. Potassium is involved in more than 60 enzyme activation in the plant and required for synthesis of proteins, vitamins, starch and cellulose. It plays important role in photosynthetic process through which plant gets energy for growth and development. It controls opening and closing of leaf stomata and thus essential for tissue water balance and water use efficiency. It increases the yield and quality of agricultural produce, enhances the ability of plants to resist biotic stress (disease, pests and insect attacks) and a-biotic stress (cold and drought). It also increases nitrogen fixation in leguminous plants. In carbohydrate rich crops like, sugarcane, potato and sugar beet, potassium has special importance owing to its vital role in formation and translocation of starch and sugar. With adequate supply of potassium, cereals produce plump grains and strong stalks. Potassium also enhances the flavor, colour and size of fruits and tubers (Kinekar, 2011).

Potassium is a costly nutrient input in India, because of its dependency on foreign countries for availability. India ranks 4th in consumption of potassium fertilizers, on an average 1.7 million tonnes of potassium are being imported annually from different country. In 2009-10,India consumed 55.10 lakh tonnes of MOP of which 42.38 lakh tones was used as a MOPfertilizer and 12.72 lakh tonnes was used through complex fertilize. In India, until the eighties, potassium did not receive much attention because of the general belief that Indian soils are well supplied with potassium.

The black soils of Maharashtra are high in available potassium, however, crops grown in black soils response well to potassium fertilizer; because, soil reserve potassium from Indian soils is getting depleted continuously and crop responses to potassium are increasing in time and space (SubbaRao*et al.,* 1993). In the earlier investigations of net depletion of K (sum total of available and non–exchangeable K) from the soil profile, following repeated cropping cycles and losses of K from the soil were quantitatively much higher than expected. In the year 2020, the deficit of K in Indian agriculture has been projected to be around 8.1 million tonnes annum^{-1} (Katyal, 2001). Naidu *et al.* (2011) reported that the available K status in Indian soils showed shift from medium to high in 1960-70 and now medium to low. Red, lateritic and shallow black soils have undergone K fertility depletion. Recent isolated studies indicated even in medium deep and deep black soils, K status has shifted from medium to low. Crops grown on these soils were found to suffer from K deficiency.

India is the 3rdlargest consumer of fertilizer. India depend upon chemical fertilizers like MOP, SOP, NOP, potassium dihydrogen phosphate, potassium silicate, potassium schoenite for K supply. This chemical fertilizers are imported and having high cost. India is fortunate to have the world's largest deposit of muscovite mica as a K –bearing mineral containing 9-10% K_2O, distributed over a total area of about 4000 sq. km in Munger district of Bihar and Koderma and Giridih district of Jharkhand. In India,waste micas are generated in large quantities during the cleaning of raw micas after their mining and are dumped near the mica mines (Nishanth and Biswas, 2008).Itis possible to use micaas a source of plant-K, if modified by chemical and/or biological means.

The availability of K in soil depends upon the kind of K – bearing minerals, their degree of weathering as well as the intensity of soil forming processes. Potassium bearing minerals in soil generally belong either to the framework silicates (K-feldspar and leucite) or layer silicates such as muscovite, phlogopite, biotite andillite (Wilson, 1992). Micas are more important than K-feldspars in supplying K to plants (Rich,1972). The prime K bearing mineral in major soils (Alluvial, Black and Ferruginous soil) of India are micas that are concentrated mainly in their silt and clay fractions(Ghosh and Bhattacharyya,1984) Both the di-andtrioctahedral micas mainly biotite and muscovite are very common in Indian soils (Kapoor*et al.,* 1981 and Pal *et al.,* 1993).

Priyono and Gilkes (2008) conducted experiment in glasshouse, in which they used milled gneiss (Micaceous clays) and potassium feldspars used as K-fertilizers with ryegrass and found that the application of K-silicate rock fertilizer containing mica mineral was advantageous for amending K-deficient soils.

Application of mica significantly enhanced biomass yield, uptake and per cent K recoveries by sudan grass than control (no-K). Biomass yield, uptake and per cent K recoveries increased further when mica was inoculated with bacterial strain in both the soils than uninoculated mica(Priyono and Gilkes,2008). In Srilankan, mica processing centre, Phlogopite used in greenhouse experiments as a K source, gave significantly higher yield of rice as compared to the control with KCL(Weerasuriya*et al.*, 1993).The above reviews suggested that, K-bearing minerals were used as source of potassium in various experimentsconducted on different crops; however there is very lesswork or experiments conducted on use ofmica mineral as a source of potassium and their effect on potato productivity.The use of mica mineral for potato has great importanceand economically profitable becausemica mineralis low in cost as compared to the chemical potash fertilizers.

In view of above facts and the earlier results on the use of K-bearing minerals in crop production, the present field experiment entitled, "Effect of mica mineral on available potassium in soil and yield of potato" was planned with following objectives:

i. To study the mica mineral as a direct source of potassium to potato.
ii. To study the effect of mica mineral on uptake of nutrient by potato.
iii. To study the effect of mica mineral on yield of potato.

2. REVIEW OF LITERATURE

Potassium application is reported to increase the size, quality and yield of tubers especially, if K supply of the soil is low to medium. In the most reports, experiments, starch content in tubers was positively correlated to potassium application. About 1.8 % K in tuber dry matter is reported to be necessary for high starch concentration.The crucial importance of potassium in productivity and quality formation is related to its rolein promoting synthesis of photosynthates in potato leaves and their transport to the tubers and to enhancing their conversion into starch, protein and vitamins, hence overall tuber bulking and tuber composition depend on K nutrition (Bansal and Trehan, 2011).

There are very few reviews appeared in the earlier literatures on use of mica as source of K and their effect on the production of potato crops, however, research, reports or data published on use of other K bearing minerals as source of potassium and their effects on crop production werereviewed and to study the effect of mica mineral on available potassium in the soil and yield of potato, the following reviews are made.

2.1 Characteristics of mica.

2.2 Potassium fertility status in Maharashtra andpotassium release.

2.3 Effect of K bearing minerals and mica as a source of potassium on biometric observation of potato.

2.4 Effect of K bearing minerals and mica as a source of potassium on yield of potato.

2.5 Effect of K bearing minerals and mica as a source ofpotassium on nutrient uptake in potato.

2.6 Effect of K bearing minerals and mica as a source ofpotassium on quality of potato.

2.7 Effect of K bearing minerals and mica as a source of potassium on soil properties.

2.1 Characteristics of mica

In Latin, mica is known as micare which mean to shine or to glitter. A group of minerals having perfect basal cleavage and capable of splitting into thin laminae is called mica. Chemically they contain complex silicate of aluminium and alkalies with hydroxyl. They crystallize in monoclinic system. Some varieties may contain iron, magnesium, lithium and rearely fluorine, barium, manganese and vandium. There are seven important mica minerals : Muscovite or potassium mica-$H_2KAl_3(SiO_4)_3$,Paragonite or sodium mica-$H_2NaAl_3(SiO_4)_3$, Lepidolite or lithium mica-$KLiAl(OH,F)_2Al(SiO_4)_3$, Phlogopiteor magnesium mica -$H_2KMg_3Al(SiO_4)_3$,Biotite or magnesium iron mica - $(H_2K)(Mg,Fe)_3Al(SiO_4)_3$, Zinnwaldite or lithium iron mica -$Li_2K_2Fe_2Al_4Si_7O_{24}$, Lepidomelane or iron mica-$(H,K)_2(Fe,Al)_4(SiO_4)_5$.(Anonymous, 2015).

Mica belongs to a very important and rather large group of minerals that are highly suitable for several applications.

However, its advanced properties make it highly suitable for use in various places. These are:

Physical

Mica is translucent, easily split into thin films along its cleavage, optically flat, colourless in thin sheets, elastic and incompressible.Micas are often a pale colour, ranging anywhere from a light grey to a pink. Sometimes, however, the pegmatite turns out to be a little more colorful, containing pink, grey, white, and black all in the same rock.

Chemical

It is a compound of hydrous silicate of aluminum, which also contains iron, magnesium, potassium, sodium fluorine, lithium and also few traces of numerous other elements. It is constant and entirely static to the action of water, acids (except for hydrofluoric and concentrated sulphuric acid), alkalies, conventional solvents, bases, and oil. It remains almost unchanged by atmospheric action.

Electrical

Mica has the exclusive combination of uniform dielectric steadiness, capacitance stability, enormous dielectric power, high Q factor and lower power loss, high electrical resistance and low temperature coefficient. It is highly regarded for its resistances to arc and corona discharge without causing any lasting injury.

Thermal

It is highly fire proof, incombustible, non- flammable, infusible, and also can resist temperatures of up to 1000 degrees Celsius/1832 degrees Fahrenheit. However this depends on the type and variety of Mica used. It has excellent thermal stability, lower heat conductivity, and can be easily exposed to high temperatures without visible effect.

Mechanical

Mica is highly tough, having high tensile strength, elastic, and along with being flexible. It has immense compression power and can be machined, die-punched, or hand cut (Anonymous, 2015).

2.1.1 Additional properties of mica

Rao and Khera (1994) reported that potassium supplying capacity of soil is vary according to presence of micaceous clays like montmorillonite, vermiculite, chlorite, kaolinite and illite. The most common mineral sources of K in soils are feldspars and micas.

Pal *et al.* (2000) reported that the prime K-bearing minerals in major soils (alluvial, black and ferruginous soils) of India are micas that are concentrated mainly in their silt and clay fractions.

Pal *et al.* (2001) reported that Petro graphic examination of sand fractions of major soils of India confirmed the presence of muscovite and biotite K bearing mineral in soils.

Surapaneni*et al.*(2002) concluded that the K supplying power of the soils is related directly to the amounts of mica present in clay fraction and that good K supplying soils will be transformed to K depleted soils as a result of increased weathering and leaching (pedogenic factors).

Mikkelsen (2007) conducted experiment in Indian soil and reported that the most common sources of K in soils are feldspars and mica. These minerals include micaceous clays such as illite and vermiculite.

Mikkelsen (2007) used crushed rocks and minerals have been evaluated as K sources in several field and greenhouse experiments. In general, plants are able to gain a very limited amount of K from minerals applied as biotite, phlogopite, muscovite, and nepheline. Feldspar K is not plant available without additional treatment or weathering. The rate of K release from minerals is influenced by factors such as soil pH, temperature, moisture, microbial activity, the reactive surface area, and the type of vegetation. Therefore, a mineral that is somewhat effective as a K source in one condition, may be ineffective in another environment.

Nishanth and Biswas (2008) studied white mica as muscovite mica; they have flake-like sheet structure, insoluble in water and hydrochloric acid (HCl), but can be solubilized by digesting with phosphoric acid (H_3PO_4) at 300–350°C for about an hour. These materials can effectively be used as a source of potassium, if modified or altered by some suitable chemical or biological means.

Priyono and Gilkes (2008) evaluated the effectiveness of intensively milled gneiss (Micaceous clay) and potassium feldspars as K-fertilizers through a glasshouse experiment with ryegrass. Priyono and Gilkes found that the application of K-silicate rock fertilizer (K-SRFs) will be most advantageous for amending K-deficient soils.

David and Manning (2009) reported that potassium feldspar is an essential component of granitic rocks, which also contain the micas biotite and muscovite. Weathering of granitic rocks initially produces secondary muscovite and chemically similar illitic clays, and if conditions are right ultimately produces the potassium-free clay mineral kaolinite.

Hale (2010) reported that Mica was found in great supply in Africa and South America during the nineteenth century, today commonly found in the Southwestern portion of the United States, with India leading the world in Mica output.

Parmar and Sindhu(2013) reported that the concentrations of solublepotassium in the soil are usually very low and more than 90% of potassium in the soil exists in the form of insoluble rocks and silicate mineralslike micas.

2.1.2 K bearing minerals and mica as a source ofpotassium for crop production

The application of potassium feldspar, which is K bearing mineral is beneficial as an alternative to KCl (muriate of potash) in Colombia, where economic and agricultural conditions, including the occurrence of oxisol soils, give rise to disadvantages with the use of KCl for crop production(Sanz-Scovinoand Rowell,1988).

Manning (1995) stated that the three main plant nutrients, N, P and K, potassium (K) and phosphorus (P) are exclusively sourced from geological materials like K bearing minerals for potassium. Both nutrients are mined and processed to give fertiliser products that vary in the amount of chemical treatment involved in their preparation.

Baeumler*et al.* (1997) reported that crushed rock materials containing mica have been promoted as nutrient sources for some time. The use of rock powders in farming is, however, sufficiently acceptable and widespread to sustain commercial activity.

Bidari*et al.* (2004) reported that plants absorb potassium only from the soil and its availability in soil is dependent upon the K dynamics as well as on total K content. Out of the three forms of potassium found in the soil, soil minerals make up more than 90 to 98 per cent of soil potassium and most of it is unavailable for plant uptake.

Bakken*et al.* (2005) proved that a rock-based fertilizer containing biotite as its main K-bearing mineral and between 5 and 20% carbonate, will release K at a slower rate than soluble K fertilizer.

Mikkelsen (2007) stated that crushed rocks and minerals have been evaluated as K sources in many field and greenhouse experiments. In general, plants are able to gain a very limited amount of K from minerals applied as biotite, phlogopite, muscovite, and nepheline.

Manning (2010) studied on mineral sources of potassium for plant nutrition. He concluded that the present high cost of environmental potassium fertilizers justifies further investigation of potassium silicate minerals and their host rocks.

K-bearing minerals, including K-feldspar, lecuite, K-mica (e.g. biotite, plogopite and glauconite) and clays minerals such as illite are the potassium source. These materials weather slowly and supply available K, therefore acting as slow release K-fertilizersconcluded that if the soils were in need of potash a big response would be secured from an application of phosphorus along with potash.

2.2 Potassium fertility status in Maharashtra and potassium release

2.2.1 Potassium fertility status in Maharashtra

Maharashtra soils are rich in potassium however, profitable response to applied K has not always been observed. In Maharashtra 28.5 to 48.0 per cent soils are high in potassium(Ghosh and Hasan, 1976).

Patil and Sonar (1992) reported thatthe potassium content of the soils of Maharashtra varies widely depending upon the composition of the parent rocks and minerals from which they are formed, the degree of weathering, the climatic conditions and cropping history. Most of the medium black soils of Maharashtra are high in available K, but low in total content as compared to other group of soils.

Talele*et al.*(1993) conducted laboratory incubation study in soils from nine locations in that, Paud (Inceptisol) contains about 1120 mg kg^{-1} total K.

Lal*et al.* (1994) reported that Inceptisols are mineral soils that have one or more pedogenic horizons *viz.*, A_2, A, B, B_2 and C. Inceptisols are of any depth, but in general, these are categorized into medium depth having silty clay loam to clayey texture and smectite (Micaceous clay) mixed with other clay minerals.

Pharande and Raskar (1995) observed that due to intensive cropping on the *TypicChromustert* (Kolhapur) and *UdicHaplustalf* (Kumbhoshi) showed low availability and K release capacity indicating possibility of depletion of reserve K. Hence, regular addition of K fertilizer is essential for maintenance of sustainable soil productivity.

2.2.2 Soil potassium release

The term potassium releasing power is the inherent capacity of the soils to supply K to growing plants from its natural source. As the quantity of exchangeable K in the immediate vicinity of the feeding tips of roots diminished, replenishment in this area takes place by the release of potassium from non-exchangeable pool.

Potassium availability to plants depends upon the amount and relative mobility of different forms of K including the rate of replenishment of available forms by reserve sources. Soil K is usually viewed as solution, exchangeable, fixed and structural K, among which soil solution K and exchangeable K are considered as available K (Wiklander, 1954).

Sparks (1980) studied the availability of K to the plants depends on dynamic equilibrium existing among the non-exchangeable, exchangeable and water soluble forms. The water soluble potassium is the form taken up directly by plants and microbes and is also subject to leaching.

Debnath and Sanyal (1996) studied the release potential of non-liable potassium in some Entisols, Alfisols and Inceptisols of West Bengal and reported about the large reserves of step-K in these soils. The step-K contents were related to illite mineral of clay fraction.

The reactions of clay bearing minerals with complexing organic acids which are produced by addition of organic residues, industrial wastes and crop residues in relation to K release from soil needs more attention for better K fertilizer management.

2.3 Effect of K bearing minerals and mica as a sourceof potassium on biometric observation of potato

Potassium is vital to many plant processes owing to its requirement for activation of at least 60 different enzymes involved in plant growth (Sulter, 1970). Potassium is also important in translocation of sugars within the plants and for the transport of the water and nutrients. Due to all these important roles K levels affects the growth of plants and literature regarding to this is presented here.

Trehan and Grewal (1990) reported that the varietal response to applied K is often related to its yield potential and number of large sized tubers it can produce. In general, rapid bulking potato varieties producing large size tubers respond more to K than the varieties with small number sized tubers as application of K is known to increase the tuber size.

Singh and Singh (1996) studied that starch accumulation is coupled with cell and tissue growth of the tubers as K enhances the overall growth of the plants

Imas and Bansal (1999) reported that application of K increases plant height, crop vigor and impart resistance against drought, frost and diseases. Potassium increases leaf expansion particularly at early stages of growth, extends leaf area duration by delaying leaf shedding near maturity. It increases both the rate and duration of tuber bulking. Its application activates number of enzymes involved in photosynthesis, carbohydrate metabolism and proteins and assists in the translocation of carbohydrates from leaves to tubers.

Anon. (2000) conducted field experiments on potato variety KufriBahar for 2 years conducted at PRII, Gurgaon also indicated that K application improved the dry matter content of tubers, which is highly essential for processing into chips and fries.

Saha (2001) found that dry matter accumulation, leaf area index, crop growth rate and tuber bulking rate increased with level of potassium in potato crop.

Trehan*et al.* (2001) reported that potassium increases the size of tubers. It increases the yield by increasing the number and yield of large sized tubers.

Shah *et al.* (2003) found that the leaf area index (LAE) and chlorophyll content showed increasing values with increasing level of potassic fertilizer in potato crop.

Bansal and trehan (2011) conducted many experiments indicate that potassium nutritioninfluences tuber size, dry matter content, susceptibility to black spot bruise, after-cooking darkening, reducing sugar content, fry colour and storage quality. Considering the fact that tuber quality parameter are related to variety, to tuber maturity,growth and site conditions, water uptake and others, making of general recommendations on the optimal K fertilizer use is a complicated issue. Potassium application is reported to increase the size of tubers, especially, if K supply of the soil is low to medium.

Abdel-Salam and Sham (2012) conducted experiment on potato crop. He usedthe most effective combination of sulphate-K and feldspar-K as a K source for potato on clay soil (50% sulphate-K + 50% as feldspar-K). This was shown positively effect on tuber size, shoots, leaf area, and total chlorophyll.

2.4 Effect of K bearing minerals and mica as a source of potassium on yield of crops

Potato being a high nutrient mining crop it needs higher amount of potassium for its economic tuber production.

Leonardos*et al.* (1987) conducted trial for beans, the greatest yields were observed in experiments with basalt applied at the equivalent of 6 T ha^{-1} and mica schist (as a source of K) applied at the equivalent of 60 kg K ha^{-1}, with fertilizer.

Leonardos*et al.* (1987) conducted experiment for napier grass, yields increased with the application of the metamorphic rocks mica schist (mica-rich) and migmatite (feldspar-rich), up to 30% greater than for a control.

Sanz-Scovino and Rowell (1988) conducted an experiment at Egypt with potassium feldspars suggest that feldspar is almost as effective as a soluble potash chemical fertilizer. Reported trials with a mix of the grass *Brachiariadyctioneura* and the legume *Puerariaphaseoloides*with the potassium feldspar, compared with muriate of potash. An increase in yield was observed, with maximum applications equivalent to 80 kg K ha^{-1}, but this was statistically insignificant.

Weerasuriya*et al.*(1993) conducted experiment in pot trials with rice used phlogopite mica and potassium feldspar, both treated with concentrated nitric acid to enhance the availability of K. Application rates were equivalent to 200 kg ha^{-1} for phlogopite and 500 kg ha^{-1} for feldspar, significant increases in rice yield (panicle number and seed weight) were observed for the use of phlogopite as compared with both control and muriate of potash.

Hinsinger*et al.* (1996) reportedfor pot experiments with wheat, used granite (2.29% K_2O) and found significantly increased (by 10%–20%) biomass yields for applications of 7.5 t rock ha^{-1}.

Badr (2006) reported that increase in the amount of available K with increasing proportions of added feldsparin experiments with mixtures of compost and feldspars. There was also a clear increase in tomato yield with increasing proportions of feldspar in the composts used, from yields of 27 tha^{-1} (control) to 45 t ha^{-1}.

Priyono and Gilkes (2008) reported that application of mica significantly enhanced biomass yield, uptake and per cent K recoveries by sudan grass than control (no-K). Biomass yield, uptake and per cent K recoveries increased further when mica was inoculated with bacterial strain in both the soils than uninoculated mica.

Abdel-Mouty and El-Greadly (2008) conducted experiment in trials with okra (Abelmoschusesculentuscv.

Eskandrani and cv.Balady), potassium feldspar was used as one of a number of treatments designed to assess crop response. Significant increases in pod yield were observed in treatments with potassium feldspar compared with a control.

Manning (2010) reported that in some circumstances, potassium silicate rocks can act as effective sources of K, with long term crop yields that meet the needs of the producer. A number of commercial enterprises use potassium silicate rocks containing mica mineral in long-standing businesses with satisfied customers.

Ghannad*et al.* (2014)reported the highest tuber yield as the most important traits was obtained from the plants treated with six tonnes per hectare of zeolite. Under different treatments, significant increased was obtained in starch content in the plants treated with 6 tonnes zeolite per hectare. A similar trend was obtained for nutrient content in the tubers. The highest levels of nutrients in the tuber were also found in the interaction effect of zeolite with humic acid.

2.5 Effect of K bearing minerals and mica as a sourceof potassium on nutrient uptake in potato

Field crops generally absorb potassium faster than they absorb N or P or build up dry matter. However, the rate of K absorption during the crop growth differs with the crop and the conditions of its growth (Tandon and Sekhon, 1988). Within limits there are variations in nutrient uptake per unit yields, depending upon crop yields, crop verities, type of soil and its K fertility status.

Rich (1972) studied the principal of K-bearing minerals in soils are potash feldspars and micas. Micas are more important than K-feldspars in supplying K to plants. Plant uptake of K is however related to the weathering of feldspars and micas in soil environments.

Dasmahapatra*et al.* (1984) conducted experiment in plains of West Bengal on two variety of potato crop and concluded that KufriJyoti was more responsive to K than KufriChandramukhi.

Mengel and Kirkby (1987) reported that it is mainly the 20 t ha^{-1} organic manure application all the three years has built soil organic matter that hold up the released K from leaching and supplied continuously at the time required by the plants.

Grewal*et al.* (1991) conducted experiment in India, a compilation of many experiments on response of potato to optimum potassium application in the presence of optimal N and P doses, showed that yield increases were as much as 52 q ha^{-1} in alluvial soils with 113 kg K_2O ha^{-1}, 45 q ha^{-1} in hill soils with 103 kg K_2O ha^{-1}, 37 q ha^{-1} in red soils with 125 kg K_2O ha^{-1} and 10 q ha^{-1} in black cotton soils with 69 kg K_2O ha^{-1} .

Perrenoud (1993) proved that a crop yielding 37 t ha^{-1} removes 113 kg N, 45 kg P_2O_5 and 196 kg K_2O per hectare. At very high yields in potato crop.

Perrenoud (1993) reported that potato crop is a heavy remover of soil potassium and is the nutrient taken up in the greatest quantity; the tubers remove 1.5 times potassiumas much as nitrogen and 4-5 times the amount of phosphate.

Sharma *et al.*(1997) studied the response to applied K had been found increase with increase in organic matter status of the soils. The agronomic efficiency (increase in tuber yield/kg K applied) varied between 0.29 t/ha in soil with low organic matter content to 0.54 t ha^{-1} in soils, containing high organic matter.

Sugiyama (2006) conducted experiment on potato and wheat and found that potato showed severe K deficiency without K application and yielded poorly while wheat was not affected under similar conditions. Total K uptake by crops was much higher than exchangeable soil K, indicating that crops may have utilized insoluble forms of K in these soils.

Chadha*et al.* (2006) and Kumar *et al.* (2009) studied of Potassium uptake by the potato plant at various growth periods and found that in first 0 days after setting the seed piece, 14 pounds of soil potassium was removed by the crop on an acre basis; 20 pounds were absorbed in next 10 days and during the period between 60-80 days, an average of 4 pounds Potassium was absorbed per acre per day.

Vijaya Lakshmi *et al.* (2010) conducted experiment on potato and reported that in general, with increase in age of the crop there was an increase in uptake of N and K up to harvest. The total N and K uptake by potato (haulm + tuber) at all the stages of crop growth *viz.*, 30, 60 DAS and at harvest significantly increased with increasing levels of nitrogen and potassium from 60 to 180 kg ha^{-1}.Combined application of nitrogen and potassium had synergistic effect on nutrient uptake.

Biswas(2011) reported that application of 50% recommended dose of NPK fertilizers (RDF) along with 4.0 Mg ha^{-1}

of enriched compost product-C prepared by rice straw and RP at4% P + waste mica 4% K +*Aspergillusawamori* resulted in 43.3% additional yield and 102.3, 67.0 and 62.2% additional N, P and K uptake by potato over control, respectively. Significant increase in yield and uptake of N, P and K by soybean grown on residual fertility were also observed over control.

Singh and Lal (2012) reported that there was significant positive interaction between N and K. At each level of N, increasing levels of K application increased the tuber yield, N and K uptake by potato at harvest. Potassium and N application improved tuber size by increasing the large and medium grade yield and decreasing the small and very small sized tuber. Maximum yield of 39.83 t ha^{-1} was obtained when N and K was applied at 225 kg ha^{-1} and 150 kg K_2O ha^{-1} against a tuber yield of only 14.36 t ha^{-1} without N and K application. The recovery efficiencies of K and N fertilizer on potato increased at 100 kg K_2O and 150 kg N ha^{-1}.

2.6 Effect of K bearing minerals and mica as a source of potassium on quality of potato

2.6.1 Market quality

Potassium nutrition influences tuber size, specific gravity, susceptibility to blackspot bruise, after-cooking darkening, reducing sugar content, fry colour, and storage quality (Perrenoud,1993).

Imas and Bansal (1999) conducted field experiments jointly by IPI, PRII and CPRI at Shimla and Jalandhar show that a balanced N x K fertilization decreased the yield of small grade tubers and increased the proportion of large marketable tubers.

Potassium application also dramatically decreased the incidence of late blight.

Sharma and Sood (2002) reported that the average tuber weight and its dry matter content increased with increasing potassium levels up to 100 kg K_2Oha^{-1}.

Lu-Yingang (2003) reported that the balanced application of NPK fertilizers can improve tuber quality of potato.

2.6.2 Starch quality

The crucial importance of potassium in quality formation is in synthesis of photosynthates and their transport to the tubers, and to enhance their conversion into starch, protein and vitamins (Mengel and Kirkby,1987).

Moinuddin*et al.* (2004) reported that K plays a key role in starch quality. Potassium is the most efficient monovalantcation that stimulates the activity of the starch synthase enzyme, catalyzing the incorporation of simple glucose molecules into complex molecules of starch.

Baniuniene and Zekaite (2008) reported that potato crop applied with only mineral fertilizers contained higher starch and dry matter content in tubers with those applied with FYM and mineral fertilizers.

Ahmad *et al.* (2009) reported that moreover, increasing of mineral potassium fertilizer up to 180 kg K_2O ha^{-1} were gradually increased starch content in the potato tubers.

Bansal and Trehan (2011) reported that in most experiments, starch content in tubers was positively correlated to potassium application. About 1.8 % K in tuber dry matter is reported to be necessary for high starch concentration.

Labib*et al.* (2012) conducted field experiment to grow potatoes on poorly sandy soils. Four treatments were followed: control using K-sulphate only; ½ K-sulphate +½ K-feldspar; ¼ K-sulphate +¾ K-feldspars and K-feldspars only. High quality of potato tubers were observed in the fourth treatment in spite of the lower yield. The addition of equal rates of K-feldspar and K-sulphate resulted in the highest content of starch, mono sucrose, protein and both vitamin C and A of potatoes. The advantages of applying K- bearing rock on poor fertility sandy soil can be related to their improvement of physical and chemical conditions.

2.7 Effect of K bearing minerals and mica as a source of potassium on soil properties

Potassium is a mobile element and does not remain in soil for long. Soil solution K either is fixed in clay lattice, or exchanged with NH_4^{+1}ionsin a exchange complex. Higher rate of application of K fertilizer has higher chances of fixation than application of little K (Schneider, 1997).

Wulf*et al.* (1998) reported that there is noteworthy increased in organic matter content in the soil after the experiment. Treatment with higher amount of K application has increased the soil K content in all the three years. It is proportional to applied K.

Han *et al.* (1999) reported thatrelease of non-exchangeable K could have increased the available K since, mica being the one of the component of silt and contributing total K that is could be positively correlated to mica and clay content in soil texture.

3. MATERIALS ANDMETHODS

An investigation was carried out by conducting a field experiment entitled, "Effect of mica mineral on available potassium in the soil and yield of potato" at the Post Graduate Farm of the Department of Soil Science and Agricultural Chemistry, Mahatma PhuleKrishiVidyapeeth, Rahuri during the *rabi*2013-14.

The details of materials used for field experiment, laboratory analysis and analytical methods adopted during the investigation are presented in this chapter under the following subheads.

3.1 Materials

3.1.1 Experimental site

The present investigation was carried out at Post Graduate Research Farm (Block B, Survey No. 51. A) of the Department of Soil Science and Agricultural Chemistry, Mahatma PhuleKrishiVidyapeeth, Rahuri during the *rabi*season of 2013-14. The experimental field is situated in between 19^0 47' N to 19^0 57' N latitude and between 74^0 18' E to 74^0 19' E. The elevation above mean sea level is 435 m.

3.1.2 Climate

The field experimental site climatically belongs to semi-arid zone with an average annual rainfall of 519 mm. The meteorological data with respect to temperature, humidity and rainfall was obtained from the Chief Scientist, All India Coordinated Project for Research on Water Management, MPKV, Rahuri and presented in Table 1. The minimum and maximumtemperature during growing period of potato crop was 7.4^{0}C to 15.2^{0}C and 28.7^{0}C to 32.4^{0}C; respectively. The minimum and maximum relative humidity during the crop growth period was 33 to 69 and 20 to 39 per cent in morning and evening; respectively. Total rainfall during the *rabi*crop growing period was 41.8 mm. Agro-climatically, this tract falls in Scarcity Zone having low rainfall and dry climate.

Table1. Average weekly meteorological data recorded during the experiment period *rabi*-2013-14

MW No.	Date	Temp (^{0}C)		RH (%)		Sunshine (hrs.)	Wind speed Km hr^{-1}	Rainfall (mm)	No. of rainy days
		Max	Min	7.30 hrs	14.30 hrs				
November 2013									
45	05 to 11	32.4	14.3	65	28	09.7	01.2	-	-
46	12 to 18	31.8	13.5	69	27	09.6	01.5	-	-
47	19 to 25	30.7	11.3	66	28	09.4	02.3	41.8	1
48	26 to 02	31.2	15.3	72	36	07.2	02.0	-	-
December 2013									
49	03 to 09	29.0	13.5	72	38	074.4	01.0	-	-
50	10 to 16	28.7	07.4	74	25	09.4	00.8	-	-
51	17to 23	29.5	09.6	55	28	09.5	02.7	-	-
52	24 to 31	29.1	13.9	67	34	08.0	01.6	-	-
January 2014									
1	01 to 07	28.8	12.2	66	37	08.2	01.7	-	-
2	08 to 14	29.5	12.3	59	34	09.1	01.5	-	-
3	15 to 21	29.7	13.5	54	34	07.9	02.5	-	-
4	22 to 28	29.0	14.8	67	39	06.2	02.0	-	-
5	29 to 04	28.5	11.2	59	31	09.3	01.4	-	-
February 2014									
6	05 to 11	31.8	11.2	54	20	10.1	01.6	-	-
7	12 to 18	28.0	10.3	54	27	10.2	03.4	-	-
8	19 to 25	31.1	15.2	56	30	09.4	02.0	-	-
9	26 to 04	30.8	13.6	51	33	09.3	03.4	000.6	-

3.1.3 Experimental soil

The soil from the experimental site of present investigation was grouped under Inceptisol order which comprises of fine montmorillioniticisohyperthemic family of *VerticHaplustepts*. The soil was medium black with a 70 cm depth having high swell shrink property. The initial values of chemical properties of experimental soil are reported in Table 2.

Table 2. Initial soil fertility status of experimental soil

Sr. No.	Parameters	Value
	Soil analysis	
1.	pH (1:2.5)	8.1
2.	EC (dSm^{-1})	0.21
3.	Available N (kg ha^{-1})	160.0
4.	Available P (kg ha^{-1})	14.9
5.	Available K (kg ha^{-1})	392
6.	Organic carbon (%)	0.44
7.	Calcium carbonate (%)	3.5
8.	DTPA Fe (mg kg^{-1})	4.53
9.	DTPA Mn (mg kg^{-1})	7.64
10.	DTPA Cu (mg kg^{-1})	1.70
11.	DTPA Zn (mg kg^{-1})	0.46

The texture of soil was clayey with low in available nitrogen (160kg ha^{-1}), moderately high available phosphorus (14.9 kg ha^{-1}) and very high in available potassium (392 kg ha^{-1}). The soil was alkaline in reaction (pH 8.1) with optimum micronutrients content.

3.1.4 Field experimental details

The cropping history of experimental field in preceding year (2012-2013) is presented in Table3.

Table 3. Cropping history of the experimental field

Sr. No.	Years	Season		
		Kharif	***Rabi***	**Summer**
1	2012-13	soyabean	Wheat	Maize

The experimental field was prepared by one ploughing and harrowing after the harvest of soyabean crop. The stubbles were removed from the field. The field experiment was laid out in randomized block design (Fig.1) with nine treatments and three replications and the other details of field experiment are given below

a.	**Experimental crop**	**:**	Potato
b.	**Variety**	**:**	KufriJyoti
c.	**Spacing**	**:**	45 cmx 30 cm
d.	**Seed rate**	**:**	20 q ha^{-1}
e.	**Recommended dose of fertilizer**	**:**	150:60:120 $N:P_2O_5:K_2O$ kg ha^{-1}
f.	**Plot size**	**:**	Gross : 4.95 m x 3.30 m Net : 4.05 m x 2.70 m
g.	**Experimental design**	**:**	Randomized Block Design
h.	**No of treatments**	**:**	Nine
i.	**Replications**	**:**	Three

The details of the treatments used in the field experiment are given in Table 4.

Table4. The details of treatments of field experiment

Sr. No.	Treatment details	Symbol
1.	N_0:P_0:100% K_2O (1200 kg ha^{-1}) through mica application	T_1
2.	Only FYM at 20 t ha^{-1}	T_2
3.	GRDF (150:60:120 N:P_2O_5:K_2O kg ha^{-1} + 20 t FYM ha^{-1})	T_3
4.	N:P_2O_5 as per RDF + 0% K_2O + 20 t FYM ha^{-1})	T_4
5.	N:P_2O_5 as per RDF + 100% K_2O(1200 kg ha^{-1}) through mica + 20 t FYM ha^{-1}	T_5
6.	N:P_2O_5 as per RDF + 25% K_2O through mica (300 kg ha^{-1}) + 20 t FYM ha^{-1}	T_6
7.	N:P_2O_5 as per RDF + 50% K_2O through mica (600 kg ha^{-1})+ 20 t FYM ha^{-1}	T_7
8.	N:P_2O_5 as per RDF + 75% K_2O (900 kg ha^{-1}) through mica + 20 t FYM ha^{-1}	T_8
9.	Absolute Control	T_9

3.1.5 Organic manures

The well decomposed FYM was obtained from the Senior Scientist, Cattle Improvement Project, Department of Animal Science and Dairy Science, MPKV, Rahuri were applied and mixed well in the experimental field.

3.1.6 Fertilizers

The fertilizers *viz.* urea (46.0 % N), single super phosphate (16 % P_2O_5) and muriate of potash (60 % K_2O) were used for applying recommended dose of N, P_2O_5 and K_2O and muscovite mica powder (10% K_2O) used as per treatments to potato and these fertilizers were procured from the Department of Soil Science and Agricultural Chemistry, MPKV, Rahuri.

3.1.7 Methods of application of manures and fertilizers

The FYM was applied before 15 days of the sowing of potato (20 tha^{-1} FYM). The N, P_2O_5 and K_2O fertilizers were applied as per treatment details. The nitrogen, phosphorus and potassium were applied through straight fertilizers in the form of urea, single super phosphate and muriate of potash and mica powder by the band placement method just before sowing of potato as per the treatments then half dose of nitrogen was applied as a basal dose at the time sowing and remaining the half dose of nitrogen was applied at 30 days after sowing as a top dressing. The calculated quantity of fertilizers *viz.*, urea 326, SSP 375 and MOP 200 kg ha^{-1} and mica powder 1200, 900,600,300 kg ha^{-1}were applied as per treatment details.

3.1.8 Seed

The seeds of the potato were procured from the Das seed company, Manchar, District: Pune.

3.1.9 Chemicals

The various chemicals used were analytical grade (A.R.) and which were procured from the Department of Soil Science and Agril. Chemistry, MPKV,Rahuri.

3.1.10 Glassware

Glasswares used for the analytical work of soil, plant and seed samples were of Borosil, Pyrex, Corning (India) made.

3.2 Methods

3.2.1 Collection of soil sample

Before sowing of potato, the composite representative soil sample was prepared by taking ten soil samples (22.5 cm) from experimental field for monitoring initial fertility status of experimental plot.

Replication wise composite soil sample for each treatment was taken by collecting together three samples from each treatments after harvest of potato. All the collected soil samples before sowing and at harvest of potato were processed by air drying under shade, ground in wooden mortar and pestle, sieved through 2 mm sieve and were used for assessing soil fertility.

3.2.2 Collection of plant samples of potato

Potato samples after harvest from each treatment were collected for analysis, dried and stored well by proper labeling for subsequent analysis.

3.2.3 Details of the field operations

The details of calendar of field operations which were carried out during the period of field experimentation on potato are presented in Table 5.

3.2.4 Growth studies

3.2.4.1 Number of tubers per plant

The total number of tubers from selected five sampled plants was counted and the mean number of tuber plant^{-1} was calculated.

3.2.4.2 Tuber and stover yield per plant

The tuber yield ha^{-1} (t ha^{-1}) was recorded after harvesting of potato plants from the net plot. Stover yield of potato per hectare was worked out from the recorded stover yield per net plot.

Table 5. Calendar of the field operations for potatoduring *rabi*season, 2013-14

Sr. No.	Field operations	Frequency	Date
A.	**Preparatory tillage**		
1.	Ploughing	1	28.11.2013
2.	Disking and harrowing	2	28.11.2013
3.	Stubble collection of previous crop	1	28.11.2013
4.	Preparation of layout	1	28.11.2013
B.	**Planting**		
1.	Planting of tubers	1	29.11.2013
C.	**Inter cultivation**		
1.	Weeding	2	30.12.2013 28.1.2014
2.	Earthning up	3	30.12.2013 13.2.2014 27.1.2014
3.	Irrigation	7	06.12.2013 19.12.2013 24.12.2013 01.01.2014 10.01.2014 03.02.2014 13.02.2014
D.	**Plant protection**		
1.	Thimet application	1	26.12.2013
2.	Spraying	6	27.12.2013 18. 1. 2014 6. 1. 2014 4. 2. 2014 10.1. 2014 11. 2. 2014
E.	**Harvesting**		
1.	Harvesting by digging	2	25.2.2014 26.2.2014

3.2.5 Chemical studies

3.2.5.1 Initial and final soil analysis

A composite soil sample up to 22.5 cm layer from the experimental area was collected prior to sowing. After harvest of the crop, soil samples up to 22.5 cm depth were taken from each net plot. These samples were analyzed to estimate the initial and final fertility status of the soil. The NPK content and other pertinent soil properties were estimated using the standard methods given in Table 7.

3.2.5.2 Total NPK uptake

The total uptake of nitrogen, phosphorus and potassium by plant was calculated by multiplying per cent nitrogen, phosphorus and potassium content in plant with their respective yield.

3.3 Standard methods for Soil and plant analysis

The standard Methods used for soil, plant, potato and mica analysis are given in Table6.

3.4 Yield

At physiological maturity potato crop was harvested and yield of potato tuber and stover was recorded and expressed as t ha^{-1}.

3.5 B: C ratio of potato cultivation

The Benefit: Cost (B:C) ratio was calculated by dividing the net monetary returns with the cost of cultivation of potato crop.

Table6. Standard methods for soil and plant analysis

Sr. No.	Parameter	Method used	Reference
1.	**Soil analysis**		
A.	**Chemical properties**		
i.	pH (1:2.5)	Potentiometric	Jackson (1973)
ii.	EC (1:2.5)	Conductometry	Jackson (1973)
iii.	Organic carbon	Wet oxidation method	Nelson and Sommers (1982)
iv.	$CaCO_3$	Acid neutralization	Allison and Morse (1965)
v.	Available N	Alkaline permanganate	Subbaiah and Asija (1956)
vi.	Available P	0.5 M $NaHCO_3$ at pH 8.5 Ascorbic acid	Olsen *et al.* (1954)
vii.	Available K	Neutral N NH_4OAC	Jackson(1973)
2.	**Plant analysis**		
i.	Total Nitrogen	Microkjeldahl (H_2SO_4:H_2O_2 1:1 digestion)	Jackson (1973)
ii.	Total Phosphorus	$HClO_4$:H_2SO_4:HCl (9:4:1)	Piper (1966)
iii.	Total Potassium	$HClO_4$:H_2SO_4:HCl (9:4:1)	Champman and Pratt (1973)
3.	Total K from mica	HF,$HClO_4$ and H_2SO_4 digestion method	Jakson(1973)
4.	Starch content	Spectrophotometry (by using anthrone reagent)	Clegg (1956)

3.6 Statistical analysis

The data on yield, nutrients and nutrients uptake by potato and soil fertility status was tabulated and processed statistically in RBD by using the methods described by Panse and Sukhatme (1985). The standard error (SE $\pm$) and critical difference (CD) values were computed from experimental data on soil and plant analysis and are reported in result Tables 7 to 16.

4. RESULTS AND DISCUSSION

The present investigation was undertaken at Post Graduate Institute Farm, M.P.K.V., Rahuri during the*Rabi* 2013-14 with a view to study the effect of mica mineral on available potassium in the soil and yield of potato. The result obtained and the observations made are presented and discussed in this chapter.

4.1 Initial soil analysis

The data in respect of initial soil analysis is reported in Table7.The observations on experimental soil indicated that Inceptisol(*Vertichaplustepts*)*Sawargaon* soil series and sandy clay in texture. The chemical composition indicated that the soil was low in available nitrogen, moderately high in available phosphorus and very high in available potassium content, low in calcium carbonate content and organic carbon. It was alkaline in reaction with (pH 8.1).

Table 7. Initial soil fertility status of experimental soil

Sr. No.	Parameters	Value
	Soil analysis	
1.	pH (1:2.5)	8.1
2.	EC (dSm^{-1})	0.21
3.	Available N (kg ha^{-1})	160.0
4.	Available P (kg ha^{-1})	14.9
5.	Available K (kg ha^{-1})	392
6.	Organic carbon (%)	0.44
7.	Calcium carbonate (%)	3.5
8.	DTPA Fe (mg kg^{-1})	4.53
9.	DTPA Mn (mg kg^{-1})	7.64
10.	DTPA Cu (mg kg^{-1})	1.70
11.	DTPA Zn (mg kg^{-1})	0.46

4.2 Chlorophyll content of Potato

The data in respect of effect of mica on total chlorophyll content in fresh leaves of potato at 45 days after planting arepresented in Table 8 andFig. 2.

The data revealed that, the treatment T_8 ($N:P_2O_5$ as per RDF + 75% K_2O through 'mica' + 20 t ha^{-1} FYM) shows significantly the highest chlorophyll content (0.94 mg g^{-1}) in potato leaves at 45 days after planting over all treatments. However, mica treatment with the N and P application also showed significantly increased in chlorophyll content in fresh leaves of potato over only mica (T_1), FYM (T_2) and control treatment (T_9).

It is documented that potassium is activator of many metabolic and enzymatic processes in plants including biosynthesis of chlorophyll(Sulter,1970).Potassium nutrition is closely associated with process of photosynthesis and transport of photosynthate to storage organs. This may explain the increase in chlorophyll content with an increase in levels of application of potash to potato in this study.

The observations in present study on chlorophyll content under influence of potassium levels are in conformity withSingh and Lal (2012).

Table8. Effect of K_2O through mica on chlorophyll content in potato crop

Tr. No.	Treatments	Total chlorophyll (mg g^{-1} fresh tissue)
T_1	N_0:P_0:100% K_2O(1200 kg ha^{-1})through mica application	0.72
T_2	Only FYM at 20 t ha^{-1}	0.79
T_3	GRDF (150:60:120 N:P_2O_5:K_2O kg ha^{-1} + 20 t ha^{-1} FYM)	0.91
T_4	N:P_2O_5 as per RDF + 0% K_2O + 20 t ha^{-1} FYM)	0.84
T_5	N:P_2O_5 as per RDF + 100% K_2O through mica + 20 t ha^{-1} FYM	0.88
T_6	N:P_2O_5 as per RDF + 25% K_2O through mica + 20 t ha^{-1} FYM	0.84
T_7	N:P_2O_5 as per RDF + 50% K_2O through mica + 20 t ha^{-1} FYM	0.89
T_8	N:P_2O_5 as per RDF + 75% K_2O through mica + 20 t ha^{-1} FYM	0.94
T_9	Absolute Control	0.65
	SE ±	**0.009**
	CD at 5%	**0.027**

4.3 Number of tubers per plant

It is evident from data (Table 9 and Fig.3) that the application of mica mineral as a source of potassium significantly increased the number of tubers per plant. It was statistically superior (11.67) in the treatment T_8 (N: P_2O_5 as per RDF + 75% K_2O through mica + 20 t ha^{-1} FYM) over all the treatments. Treatment T_5 and T_3 were statistically superior over all treatments except $T_8$and at par with each other.Treatment T_9 (control) was statistically inferior over all the treatments.

In earlier observations, it is noticed that potassium influences chlorophyll content. It helps to fix nutrients by activating many plant enzymes. Potassium also regulates water absorption by root and water economy which may helps to convert nutrient flow to tuber developmentand increases tuber numbers of potato. Same statements has been given by Verma*et al.* (1997) andSharif Hossain *et al.* (2003) in their repals.

Table 9. Effect of K_2O through mica on number oftubersper plant of potato

Tr. No.	Treatments	No. of tubersper plant
T_1	N_0:P_0:100% K_2O(1200 kg ha^{-1})through mica application	8.00
T_2	Only FYM at 20 t ha^{-1}	8.00
T_3	GRDF (150:60:120 N:P_2O_5:K_2Okg ha^{-1} + 20 t ha^{-1} FYM)	10.33
T_4	N:P_2O_5 as per RDF + 0% K_2O +20 t ha^{-1} FYM)	7.67
T_5	N:P_2O_5 as per RDF + 100% K_2O through mica + 20 t ha^{-1} FYM	10.67
T_6	N:P_2O_5 as per RDF + 25% K_2O through mica + 20 t ha^{-1} FYM	9.00
T_7	N:P_2O_5 as per RDF + 50% K_2O through mica + 20 t ha^{-1} FYM	9.33
T_8	N:P_2O_5 as per RDF + 75% K_2O through mica + 20 t ha^{-1} FYM	11.67
T_9	Absolute Control	7.33
	SE ±	**0.549**
	CD at 5%	**1.659**

4.4 Yield ofpotato

The data on effect of mica on different grade wise yield and total yield of potato are presented in Table 10 andthe same is graphically depicted in Fig.s4a and 4b respectively.

The data revealed that,in Grade 1 (>75 gm), the application of treatment T_8 (N:P_2O_5 as per RD + 75% K_2O through mica + 20 t ha^{-1} FYM)recorded significantly superior inpotato yield (7.69 t ha^{-1}).

In case of Grade 2 (25-75 gm), the application of treatment T_8 ($N:P_2O_5$ as per RDF + 75% K_2O through mica + 20 t ha^{-1} FYM) also recorded significantly the highest tuber yield of potato (6.06 t ha^{-1}). However, thetreatment $T_8$was at par with T_3 and T_5.

The application of treatment T_7 ($N:P_2O_5$ as per RDF + 0% K_2O + 20 t ha^{-1} FYM) recorded significantly the highesttuber yield of potato (6.16 t ha^{-1}) in Grade 3 (<25 gm).

In general, the application of treatment T_8 recorded thehighest in Grade 1 (>75 gm) and Grade 2 (75-25 gm) for tuber yield of potato. Whereas, the application of treatment T_7recordedthe highest tuber yield of potatoin Grade 3 (<25 gm).

The application of treatment T_8 (N: P_2O_5 as par RDF + 75% K_2O through mica + 20 t ha^{-1} FYM) recorded statistically superior over all treatments in total yield of potato(18.93 t ha^{-1}). Treatment T_3(18.29t ha^{-1}) and T_8(18.93t ha^{-1}) was statistically at par witheach other. In case of stover yield of potato the results were non-significant.

The potassium is known to play role in absorption, translocation and many metabolic and physiological processes in plant and regulating growth and dry matter yield of plants.Potassium is associated with absorption of water, nutrients, synthesis and translocation of carbohydrates within the plant. This role of K stimulates growth of plant. It activates more than 60 plant enzymes regulating many metabolic processes including essential

Table 3. Effect of K_2O through mica on yield of potato and B:C ratio

Tr. No.	Grade wise potato yield (t ha^{-1})			Total potato yield (t ha^{-1})	
	Grade 1 (> 75 gm)	Grade 2 (75 –25 gm)	Grade 3 (< 25 gm)	Tuber	Stover
T_1	4.09	3.51	3.94	11.54	1.83
T_2	5.70	5.51	3.96	15.17	1.87
T_3	6.43	6.00	5.86	18.29	1.98
T_4	5.72	5.11	4.65	15.48	1.65
T_5	6.36	5.82	5.8	17.98	2.08
T_6	5.00	5.26	5.24	15.50	1.74
T_7	5.55	5.1	6.16	16.81	1.66
T_8	7.69	6.06	5.18	18.93	1.80
T_9	2.08	2.05	4.62	8.75	1.33
SE ±	**0.201**	**0.339**	**0.156**	**0.933**	**0.171**
CD at 5%	**0.609**	**1.026**	**0.471**	**2.820**	**N.S.**

4.5 Total uptake of nutrients

The data on effect of mica on total nutrient uptake of potato at the harvest is presented in Table 11 and Fig.5. The applied treatments showed significant variationswith respect to total uptake of nutrients at harvest of potato.

The application of treatment T_8 (N: P_2O_5 as per RDF + 75% K_2O through mica + 20 t ha^{-1} FYM) recorded significantly the highest uptake of nitrogen (45.10 Kg ha^{-1}) and potassium(103.86 kg ha^{-1}). However,in case of nitrogen T_8 was at par with T_3. The application of treatment T_3 (GRDF-150:60:120 N:P_2O_5:K_2O kg ha^{-1} + 20 t ha^{-1}FYM) recorded significantly superior uptake of phosphorus only (33.54 kg ha^{-1}) over all treatments. However, T_3 was at par with treatments T_8 and T_5.

Blevins *et al.* (1978) concluded that potassium has an important role as a counter ion for the uptake and translocation of nitrate (NO_3^-) within the plant. The increase in nitrogen concentration in leaves and tuber could be due to close relationship between K and nitrogen assimilation.

According to Turner (1987), potassium was found to regulate the transfer of nutrients to the xylem and also K influence phosphorus supply to xylem. These may be reasons to increase phosphorus uptake when K is sufficiently available to the plants.

The observations in the present study are similar to observations reported by Bisht and Chandel (1996) and Joshi (2007).Singh and Lal (2012) reported that there was significant positive interaction between N and K. At each level of N, increasing levels of K application increased the tuber yield, N and K uptake by potato at harvest.

Table 11. Effect of K_2O through mica on total nutrient uptake ($kg\ ha^{-1}$) of potato

Tr. No.	Treatments	Total nutrient uptake ($kg\ ha^{-1}$)		
		N	**P**	**K**
T_1	N_0:P_0:100% K_2O (1200 kg ha^{-1}) through mica application	28.52	18.67	57.05
T_2	Only FYM at 20 t ha^{-1}	36.01	25.19	62.87
T_3	GRDF (150:60:120 N:P_2O_5:K_2O kg ha^{-1} + 20 t ha^{-1} FYM)	44.01	33.54	95.12
T_4	N:P_2O_5 as per RDF + 0% K_2O + 20 t ha^{-1} FYM)	39.27	27.73	56.60
T_5	N:P_2O_5 as per RDF + 100% K_2O through mica + 20 t ha^{-1} FYM	41.77	30.03	85.50
T_6	N:P_2O_5 as per RDF + 25% K_2O through mica + 20 t ha^{-1} FYM	37.95	25.50	80.71
T_7	N:P_2O_5 as per RDF + 50% K_2O through mica + 20 t ha^{-1} FYM	37.43	23.51	81.29
T_8	N:P_2O_5 as per RDF + 75% K_2O through mica + 20 t ha^{-1} FYM	45.10	30.72	103.86
T_9	Absolute Control	20.85	13.37	39.12
	SE ±	**1.988**	**3.503**	**08.168**
	CD at 5%	**6.011**	**10.592**	**24.488**

4.6 Fertility status of soil at harvest

The data on effect of mica on fertility status of soil at harvest of potato is presented in Table 12. The application of mica did not show any significant results in case of chemical properties of soil at harvest of potato. This may be due to application of mica treatments was given to only one season duration crop.

In terms of numerical data, the pH values found to be increased in all treatments over T_9 (Absolute control). The application of T_7 (N: P_2O_5 as per RDF+ 50 % K_2O through mica + 20 t ha^{-1} FYM) showed the highest pH (8.14). It was found that with increased doses of mica, the pH values also increased over

T_9(Absolute control). The application of treatment T_6 (N: P_2O_5 as per RDF + 25% K_2O through mica + 20 t ha^{-1} FYM) and T_1 (100% mica application) showed the highest EC values (0.29 and 0.26 dSm^{-1}) respectively. The soil organic carbon content values found to be increased in all treatments over T_9 (Absolute control). It was highest (0.58 %) in T_2 (Only FYM at 20 t ha^{-1}).

The calcium carbonate values found to be slightly increased in all treatments over T_9 (Absolute control). The application of treatment T_5 (N: P_2O_5 as per RDF + 100 % K_2O through mica + 20 t ha^{-1} FYM) showed the lowest calcium carbonate(2.31%) at harvest of potato.

Table12. Effect of K_2Othrough mica on chemical properties ofsoil at harvest of potato

Tr. No.	Treatments	pH (1:2.5)	EC (dSm^{-1})	Org. Carbon (%)	$CaCO_3$ (%)
T_1	N_0:P_0:100% K_2O (1200 kg ha^{-1}) through mica application	8.08	0.26	0.49	2.54
T_2	Only FYM at 20 t ha^{-1}	8.12	0.22	0.58	2.75
T_3	GRDF (150:60:120 N:P_2O_5:K_2O kg ha^{-1} + 20 t ha^{-1} FYM)	8.10	0.22	0.52	2.53
T_4	N:P_2O_5 as per RDF + 0% K_2O + 20 t ha^{-1} FYM)	8.10	0.20	0.52	2.86
T_5	N:P_2O_5 as per RDF + 100% K_2O through mica + 20 t ha^{-1} FYM	8.11	0.26	0.55	2.31
T_6	N:P_2O_5 as per RDF + 25% K_2O through mica + 20 t ha^{-1} FYM	8.07	0.29	0.52	2.69
T_7	N:P_2O_5 as per RDF + 50% K_2O through mica + 20 t ha^{-1} FYM	8.14	0.21	0.55	2.97
T_8	N:P_2O_5 as per RDF + 75% K_2O through mica + 20 t ha^{-1} FYM	8.10	0.25	0.56	2.82
T_9	Absolute Control	8.01	0.24	0.48	2.33
	SE ±	**0.042**	**0.024**	**0.022**	**0.228**
	CD at 5%	**N.S.**	**N.S.**	**N.S.**	**N.S.**

4.7 Available nutrients in soil at harvest of potato

The data on effect of mica on soil available macro nutrients at harvest of potato is presented in Table13.The application of treatment T_8 (N: P_2O_5 as per RDF + 75% K_2O through mica + 20 t ha^{-1}FYM) showed significantly high residual soil available potassium (582.40 kg ha^{-1}) over all the treatments. However, in case of soil available nitrogen and phosphorus the results were non-significant.

While comparing above results in terms of numerical values, the GRDFT_3treatment (150:60:120 N:P_2O_5:K_2O kg ha^{-1} + 20 t ha^{-1} FYM) showed the highest (244.03 kg ha^{-1}) soil available nitrogen. It was found that with increased doses of mica application, the soil available nitrogen decreased. This may be due to higher uptake of nitrogen as influenced by mica (K) application and availability of K to crop.

The application of T_3 (GRDF-150:60:120 N:P_2O_5:K_2O kg ha^{-1} + 20 t ha^{-1} FYM) and T_5 (N:P_2O_5 as per RDF +100% K_2O through mica + 20 t ha^{-1} FYM) recorded the highest soil available phosphorus. The application of T_1 (100% mica application) showed the lowest values (13.68 kg ha^{-1}) of soil available phosphorus. This indicates that only 100% mica application enhanced phosphorus uptake by potato.

The data on effect of mica on soil available micronutrients at harvest of potato is presented in Table 14. The application of mica through treatment T_5 (N: P_2O_5 as per RDF + 100 % K_2O through mica + 20 t ha^{-1} FYM) recorded significantly the highest DTPA- Zn in soil (0.80 μg g^{-1}). However, it was at par with treatment T_1 (100% mica application). Whereas, results were found to be non-significant in case of soil available DTPA- Fe, Mn and Cu at harvest of potato.

Turner (1987) concluded that K was found to regulate the transfer of nutrients to the xylem, where K supply is low, N, P and micronutrients across the xylem is restricted.In the present investigation, availability of nutrients is increased as compared to treatments receiving no potassium. This role of K explained the changes in available N, P and micronutrients.

Table 13. Effect of K_2O through mica on soil available macronutrients at harvest of potato and potassium use efficiency

Tr. No.	Treatments	Soil available nutrients (kg ha^{-1})			
		N	P	K	PUE (kg/kg)
T_1	N_0:P_0:100% K_2O (1200 kg ha^{-1}) through mica application	188.16	13.68	442.43	6
T_2	Only FYM at 20 t ha^{-1}	202.79	15.52	459.20	-
T_3	GRDF (150:60:120 N:P_2O_5:K_2Okg ha^{-1} + 20 t ha^{-1} FYM)	244.03	16.99	435.80	79.5
T_4	N:P_2O_5 as per RDF + 0% K_2O + 20 t ha^{-1} FYM)	213.24	16.18	423.00	-
T_5	N:P_2O_5 as per RDF + 100% K_2O through mica + 20 t ha^{-1} FYM	203.48	18.00	491.90	7.69
T_6	N:P_2O_5 as per RDF + 25% K_2O through mica + 20 t ha^{-1} FYM	203.84	13.81	462.93	22.5
T_7	N:P_2O_5 as per RDF + 50% K_2O through mica + 20 t ha^{-1} FYM	206.97	16.00	451.47	1.92
T_8	N:P_2O_5 as per RDF + 75% K_2O through mica + 20 t ha^{-1} FYM	210.44	15.56	582.40	2.16
T_9	Absolute Control	209.18	13.95	308.00	0
	SE ±	**13.419**	**1.215**	**12.757**	-
	CD at 5%	**N.S.**	**N.S.**	**38.574**	**-**

Table 14. Effect of K_2O through mica on soil available micronutrients at harvest of potato

Tr. No.	Soil DTPA micronutrient (µg g^{-1})			
	Fe	Mn	Zn	Cu
T_1	4.38	14.58	0.79	2.35
T_2	4.28	14.33	0.60	2.06
T_3	4.22	16.57	0.68	2.30
T_4	4.28	14.59	0.63	2.31
T_5	4.44	15.89	0.80	2.55
T_6	4.28	11.05	0.64	2.24
T_7	4.40	12.13	0.74	2.61
T_8	4.10	14.28	0.69	2.43
T_9	4.47	14.03	0.65	2.50
SE ±	**0.115**	**1.496**	**0.037**	**0.308**
CD at 5%	**N.S.**	**N.S.**	**0.112**	**N.S.**

4.8 Starch content (%) in the potato

The data in respect of mica on starch content in potato at harvesting stage is presented in Table 15and depicted inFig.6.

The data revealed that, the treatment T_8 (N: P_2O_5 as per RDF + 75% K_2O through mica + 20 t ha^{-1} FYM) was significantly superior over all treatments in starch content(12.21%) in potato tuber at harvesting stage. Treatment $T_9$was found inferior over all treatments. Treatment T_2 and $T_3$was statistically superior over all treatments except T_8 and at par with each other.

Bansal and Trehan (2011) reported that in most experiments, starch content in tubers was positively correlated to potassium application. About 1.8 % K in tuber dry matter was reported to be necessary for high starch concentration.

Table 15. Effect of K_2O through mica on starch content (%) in the potato

Tr. No.	Treatments	Starch content (%)
T_1	N_0:P_0:100% K_2O(1200 kg ha-1)through mica application	9.97
T_2	Only FYM at 20 t ha^{-1}	11.12
T_3	GRDF (150:60:120 N:P_2O_5:K_2O kg ha^{-1} + 20 t FYM ha^{-1})	11.05
T_4	N:P_2O_5 as per RDF + 0% K_2O + 20 t FYM ha^{-1})	09.54
T_5	N:P_2O_5 as per RDF + 100% K_2O through mica + 20 t FYM ha^{-1}	10.58
T_6	N:P_2O_5 as per RDF + 25% K_2O through mica + 20 t FYM ha^{-1}	10.54
T_7	N:P_2O_5 as per RDF + 50% K_2O through mica + 20 t FYM ha^{-1}	10.18
T_8	N:P_2O_5 as per RDF + 75% K_2O through mica + 20 t FYM ha^{-1}	12.21
T_9	Absolute Control	08.37
	SE(+)	**0.317**
	CD @5%	**0.950**

4.9 Total K from mica

In mica sample total K was found 8.33% and K_2O was 10%, which was determinedby using'HF,$HClO_4$ and H_2SO_4 digestion method',Jackson (1973).

4.10 Benefit: cost ratio of potato cultivation

The data regarding to Benefit: Cost ratio is presented in Table 16. The highest B:C ratio was observed in treatment T_8(N: P_2O_5 as per RDF + 75% K_2O through mica + 20 t FYM ha^{-1})was 1.30. The observed B:C ratio in treatment T_3,GRDF (150:60:120 N:P_2O_5:K_2O kg ha^{-1} + 20 t FYM ha^{-1})was 1.23. On the basis of comparison of B:C ratios observed in all treatments, the treatment

T_8 recorded higher B:C ratio than all treatments. These B:C ratio observations further suggest to recommended treatment T_8 (N: P_2O_5 as per RDF + 75% K_2O through mica + 20 t FYM ha^{-1}) for the maximum economic profit from potato cultivation in Inceptisol soil.

Table 16. Benefit: Cost ratio of potato cultivation

Tr. No.	Yield (t ha^{-1})		Cost of cultivation (Rs.)	Gross monetary returns (Rs.)	Net returns (Rs.)	B:C Ratio
	Tuber	Stover				
T_1	11.54	1.83	56658.17	57883.00	1224.83	1.02
T_2	15.17	1.87	65667.00	76037.00	10370	1.16
T_3	18.29	1.98	74729.15	91648.00	16918.85	1.23
T_4	1548	1.65	70989.47	77565.00	6575.53	1.09
T_5	17.98	2.08	73533.47	77674.00	4140.53	1.06
T_6	15.50	1.74	71625.47	77674.00	6048.53	1.08
T_7	16.81	1.66	72261.47	84216.00	11954.53	1.17
T_8	18.93	1.80	72897.47	94830.00	21932.53	1.30
T_9	8.75	1.33	44467.00	43883.00	-584.00	0.99

5. SUMMARY AND CONCLUSION

The present field investigation was carried out to study the effect of mica mineral on available potassium in the soil and yield of potato at Post Graduate Institute Farm, Department of Soil Science and Agricultural Chemistry, M.P.K.V, Rahuri during the *Rabi* 2013-14. It was laid out in Randomized Block Design with three replications. There were five levels of mica mineral (100%, 75%, 50%, 25% and 0% with recommended N, P and 20 t ha^{-1}FYM combination).

The experimental soil belonged to Sawargaon soil series of Inceptisolorder.The representative surface composite soil samples (0-22.5 cm) were collected from each plot after harvest of potato for soil chemical analysis.

The experimental soil was moderately high in potassium content. The yield of potato and starch content in the potato was recorded to evaluate the treatment effects. The chlorophyll content of potato at harvesting stage, the uptake of potassium was recorded. The content of N,P and K in potato and leaves and available N, P, K and organic carbon and calcium carbonate content of soil were estimated.The important findings emerged from this investigation are summarized below.

5.1 Summary

5.1.1 Effect of mica mineral on chlorophyllcontent in the potato crop

The chlorophyll content was increased significantly due to application of mica mineral as a source of potassium at various levels. The chlorophyll contentincreased significantly due to application of 75% K_2O through mica *i.e.,*900 kg $ha^{-1}$with recommended dose of $N:P_2O_5$(150:60 kg ha^{-1})and 20 t ha^{-1} FYM.

5.1.2 Effect of mica mineral on number of tubers

At harvest, the mean number of tubers per plant was recorded the highest (11.67) in treatment T_8 due to application of 75% K_2O through mica i.e.900 kg $ha^{-1}$with recommended dose of $N:P_2O_5$ (150:60 kg ha^{-1})and 20 t ha^{-1} FYM.

Treatment T_9(control), recorded the least number of potato tuber per plant (7.33). In small sized tuber (<25gm), number of potato was less in treatment T_1 (3.94), (N_0:P_0:1200 kg K_2O through mica) and T_2 (3.96), (only FYM at 20 t ha^{-1})and the highest in T_4(6.16), ($N:P_2O_5$ as per RD+ 0 K_2O + 20 t ha^{-1} FYM).The medium sized potato tuber (25-75gm) and large sized potato tuber (>75gm) were highest in treatment T_8*i.e.*,K_2O through mica(900 kg ha^{-1})with recommended dose of $N:P_2O_5$(150:60 kg ha^{-1})and 20 t ha^{-1} FYM.

5.1.3 Effect of mica mineral on yield of potato crop

The yield was increased significantly due to application of mica mineral at various levels. The tuber yield of potato increased significantly due to application of 75% K_2O through mica i.e.900 kg $ha^{-1}$with recommended dose of $N:P_2O_5$(150:60 kg ha^{-1})and 20 t ha^{-1} FYM.

5.1.4 Effect of mica mineral on total nutrient uptake by potato crop and starch content in potato

The uptake of potassium by the potato tuber and leaves also increased significantly due to application of 75% K_2O through mica i.e. 900 kg $ha^{-1}$with recommended dose of N:P_2O_5 (150:60 kg ha^{-1})and 20 t ha^{-1} FYM.

The total uptake of nitrogen and phosphorus in potato tuber and leaves increased significantly due to application of 900 kg ha^{-1} over other treatments.

The treatment T_8 (N: P_2O_5 as per RDF + 75% K_2O through mica + 20 t ha^{-1} FYM) was significantly superior over all treatments in starch content in potato tuber at harvesting stage (12.21%).

5.1.5 Effect of mica mineral on chemical properties and available nutrient in soil

The non significant effect of mica application to potato on pH and EC of soil and on organic carbon and calcium carbonate after harvest of crop were recorded. However the available nitrogen, phosphorus, potassium content of soil after harvested of crop were higher as the level of mica application increased.

5.2 Conclusion

It is concluded that, the application of75% K_2O(900 kg ha^{-1}) through mica with recommended dose of N (150 kg ha^{-1}), P_2O_5(60 kg ha^{-1}) and 20 t ha^{-1} FYM was found to significantly increase the chlorophyll content (0.94 mg g^{-1}) in leaves, number of tubers per plant (11.67), potato tuber yield (18.93 t ha^{-1}), totalpotassium uptake (K-103.86 kg ha^{-1}),available potassium in soil (582.40 kg ha^{-1}) and starch content in potato (12.21%).

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*** Original not seen**

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of

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