Chapter 1

INTRODUCTION

Oil seeds are grown widely in countries such as India, China, Argentina, Canada, France, Nigeria, North Central America, USA and Western Europe. India is one of the leading oil seed producing country in the world but up to now it is unable to fulfill the edible oil requirement of its burgeoning population. Important states growing oil seeds in India are Madhya Pradesh, Rajasthan, Maharashtra, Karnataka, Uttar Pradesh, Tamilnandu, Haryana, and West Bengal. Present production of oil seeds in India is around 28.83 million tons from 26.54 million hectare with an average productivity of 1086 Kg ha⁻¹ (Anonymous, 2011-12).

Oil seeds play an important role in Indian agriculture and industries. Besides immense value in our diet, oils and fats are used in cosmetics soaps, lubricants, paints, and varnish industries and their medicinal and therapeutic values are well documented and recognized.

India holds a premier position in the global scenario accounting for 19% of the total area and 9% of production, however the productivity in India is only 1086 Kg ha⁻¹ as compare to world level of 1632 kg ha⁻¹. Rapeseed-mustard(R/M) occupies the second important position in oil seeds next to the groundnut. Though the efforts made by Technology Mission on oil seeds of GOI has resulted some improvement in the subsequent year in R/M scenario due to development of new location specific efficient high yielding varieties.(The Hindu survey of Indian Agriculture, 2010). Indian mustard (Brassica juncea L.) is an important winter oilseed crop of cruciferae family. The crop is predominantly
cultivated in China, India and Pakistan & these Countries contribute about 90% production of the world.

In India, mustard is cultivated over an area of 6.43 million hectare with production of 5.92 MT of seeds. The average yield of mustard in country is 920 kg ha\(^{-1}\) (Economic survey, 2010-11). In India, Rajasthan ranks first both in area (2.33 M ha) and production (2.70 MT) and Gujrat state has the highest productivity (1510 kg ha\(^{-1}\)) of mustard. In Uttar Pradesh, mustard is grown on 12.95 lakh ha area with production of 8.00 lakh tones and productivity of 730 kg per hectare (Economic Survey, 2010-11).

In addition to being an important edible oil, mustard oil is used for a number of industrial products. Mustard oil contains unsaturated fat which is beneficial to heart patients. The seed and oil of mustard contains a glucosinolate ‘Singrin’ which creates pungency making it suitable for preparation of pickles, curries and frying vegetables. The oilseed cake is used as cattle feed and manure.

The low productivity of oilseed is mainly due to their cultivation on lands with marginal moisture and nutrient constrains. Besides N, P & S has been reported to be one of the limiting factor for increasing oil seed production in northern India, where the soils are marginal to medium in sulphur content. Adoption of improved high yielding crop varieties under intensive cropping system leads to great depletion of sulphur and other nutrients along with nitrogen and phosphorus.

As nutrients are the key inputs for higher yields the interaction among the nutrients (N X P, N X K, P X K, N X P X K, NPK with S, NPK with Organic manures, NPK with micro and secondary nutrients and NPK with biofertilizers) is the most important factor responsible for the yield of
oilseed crops. Though several interactive nutrients management technologies are available for different oilseed grown in different states of the country, their potential in increasing yield has not been exploited properly. There exists a scope for further increasing the oilseed productivity through harvesting the interaction effects of nutrients (Mandal et al. (2002)).

Besides the major nutrients sulphur plays an important role in Indian mustard, which are insufficient in most of Indian soil. According to Tandon (1991) widespread sulphur deficiency has been observed in crops and soils in 120 districts of India irrespective of soil texture and cropping pattern, including Bulandshahr district of western Uttar Pradesh. In Indian mustard, sulphur plays an important role in the formation of amino acid, synthesis of protein, chlorophyll and oils (Mishra et al. 2003). It is also a constituent of mustard oil glucoside which imparts characteristic odour and flavour to the oil. Thus, supplementation of sulphur as fertilizer is necessary along with nitrogen, phosphorus and potassium.

Nitrogen is one of the important plant nutrient and it invariably improves the vegetative growth which is manifested through better plant height, primary branches, secondary branches, siliqua plant$^{-1}$, dry matter production which ultimately leads to higher seed yield. Nitrogen also improves the quality of produce. However, by addition of fertilizer nitrogen dose beyond certain limits decrease the oil content, but protein content in seed has been reported to increase significantly.

Both nitrogen and sulphur are closely linked in protein metabolism and thus the relationship between S and N in plant reported to be synergistic and of greater importance. N and S are said to increase the concentration and uptake of one another in the plant.
Phosphorus is also essential for plant growth, cell division, root growth and cell elongation, seed and fruit development and early ripening. It is a constituent of several organic compounds including oils and amino acids. P-Compounds such as ADP, ATP in fact, act as energy currency within the plants. Sensitivity of oilseed crops to phosphorus deficiency greatly varies. This is evident from the visible symptoms being visible on plants grown at low phosphorus supply.

Potassium is also necessary for higher yield & good quality of the produce as well for high response of N & P.

Sulphur is now recognized as the 4th major plant nutrient, along with nitrogen, phosphorus and potassium. It is essential for the growth and the development of all crops without exception. Most of a plant’s requirement of S is absorbed through the plant roots in $\text{SO}_4^{2-}$ (Sulphate) form.

Sulphur plays a role in formation of chlorophyll, the green substance in leaves that permits photosynthesis, plant products such as starch, sugars, oils, fats, vitamins and other vital compounds through photosynthesis. It helps in protein production primarily because S is a constituent of three essential amino acids (Cysteine, Cystine and Methionine) which are the building blocks of protein this increases protein content. About 90% of plant S is found in these amino acids.

Farm yard manure (FYM) is the traditional manure that has been used for crop production but FYM alone can’t furnish plant nutrient as per nutrients need of the plants. Results of various field experiments have shown that integrated use of chemical fertilizers and FYM not only increased soil productivity but also ensures better quality of produce as well as improves residual soil fertility. Application of organic manures with recommended doses of fertilizers maintain soil organic carbon as well as

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improves availability of other micro plant nutrient elements and fertilizer use efficiency. Continual use of bio fertilizer along with organic and inorganic manures over the years has also resulted in reduction in pest and disease problem, besides building resistance in plant to pest and diseases (Rangnathan and Christopher, 1996).

Among the biofertilizers, Azotobacter is the most important and well known free living nitrogen fixing bacterium and capable of fixing 20 -30 kg N ha$^{-1}$. Integration of azotobacter with FYM helps its better growth since if carbon requirement is very high. Apart from fixing nitrogen, Azotobacter produces a number of biologically active compounds and at least a part of reported increase in yield may be due to this factor. Disease incidence such as blight, white rust and stag head formation were found to have reduced by the inoculation of different strains of Azotobacter (Narula et al., 1993).

It has been well established that neither inorganics nor organics or biological alone can furnish nutrients enough resulting higher yield with better quality of produce. Therefore, investigation of all possible sources of nutrient might have done for augmenting higher productivity as well improved quality of the produce.

The INM refers to efficient and judicious use of all the major sources of plant nutrients in an integrated manner was to get maximum economic yield without any deteriorating effect on soil and environment, rather improvement in soil fertility for sustained productivity on a long term basis.

Mustard is a common crop grown in Rabi season throughout the state of UP. Due to uncertainly of weather conditions moong which was traditionally grown in kharif season is being raised as Zaid crop after
harvesting of mustard. Hence mustard-moong crop sequence is becoming popular and being accepted by the farmers of U.P. under assured irrigated conditions, for sustained crop productivity.

**Pulses** from an integral part of the vegetarian diet in the Indian subcontinent, besides being a rich source of protein, they maintain soil fertility through biological nitrogen fixation by bacteria, present in root nodules and thus play a vital role in furthering sustainable agriculture. The area under pulses crop at present is around 23 million ha. The production around 15 million tons and productivity about 650 kg ha\(^{-1}\). Summer moong often referred to as bonus crop would invariably increase residual fertility and soil health besides giving some produce.

It is also well recognized that the proportion of fertilizers taken up by single crop often quite low and these fertilizers have residual value, which the succeeding crop can utilize. The magnitude of the residual effect depend on the rate and the kind of fertilizer used, the cropping and management system followed and to a great extent on the type of soil. The residual value of applied fertilizers and manures being greater in pulses especially under assured irrigated conditions.

Keeping in view of these facts an investigation entitled "**Studies on the Effect of Integrated Nutrient Management on Soil Properties, Yield and Quality of Mustard and its Residual effect on Summer Moong**" was planned and executed with following objectives:

1. To study the Effect of Integrated Nutrient Management (INM) on Yield & Quality of Mustard.
2. To find out the Effect of Integrated Nutrient Management on Nutrient uptake by Mustard.
3. To study the Effect of Integrated Nutrient Management on Properties of Soil and Residual fertility.
4. To find out the Residual effect of various nutrient combinations of Summer Moong.
5. To study the Residual effect of various combinations of nutrients applied to Mustard on nutrient uptake by Summer Moong.

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