INTRODUCTION

India is one of the largest oilseeds producing country that covers nearly one-fifth of the world’s oil seed production in terms of area under the cultivation. The country also enjoys a distinct position in terms of rich diversity of annual oilseed crops. After setting up of technology mission on oilseed (TMO) in 1986, there was tremendous increase in oilseed production which increased from 10.83 tones (1985-86) to 24.75 lakh tones (1998-99) (Singh, 1997). The average productivity of oilseeds in India is only 935 Kg/ha as compared to the world average of 1632 Kg/ha. The Country have 19 % of world area under oilseeds, which accounts for only 9% of world’s production to meet the need of 16 % of the population (Pal and Gangwar, 2004). Except castor, the productivity of most of the oil seed is only 40-60 % of the world productivity. A great degree of variability in yield is observed as nearly 74 % oilseed area is rainfed and suffers from availability of moisture with the exception of rapeseed, mustard and castor. The irrigated area in other oil seed crops varies from less than 1 % in sunflower and niger to about 19 % in groundnut (Pal et al., 2004). The inherent risk associated with rainfed oilseed cultivation prevents most of the farmers from investing in inputs like fertilizers and plant protection besides good crop management practices. Oilseed comprise of the second largest commodity after cereals in India, sharing 14 % of the gross cropped area and accounting for 5 % of the gross national production covering 10 % of the value of the agricultural products (Pal et al.,2004). The demand for oilseeds in India is growing at the rate of about 6% per annum during the last two decades. The edible oil demand in India is not only income elastic but also price elastic. Economic growth in developing countries is projected at about a 5-percent annual rate in 2006-15 (Ghosh, 2005 and USDA, 2006). Developing countries play an increasingly
important role in global growth in food demand and become a more important
destination for U.S. exports. Relatively high income growth, along with large
food responsiveness to income growth in these countries, underlies this
projection. Consumption and imports of food and feed in developing countries
are particularly responsive to income changes. As incomes rise in these countries,
consumers generally diversify their diets, moving away from staple foods to
include more meat, fruits, vegetables, and processed foods (including vegetable
oils). These consumption shifts increase import demand for feedstuffs and high-
value food products (USDA, 2006). By 2010 our population may reach 1180
million. If the per capita consumption of oils and fats is fixed at only 15 Kg per
year even then our edible oil need will be 17.7 million tones by 2010, for which
about 51 million tones of oilseeds will be required. This clearly shows that the
oilseed production has to be doubled in the next ten years to meet the demand of
the increasing population in the country (Pal et al., 2004).

The production of oil seeds has increased at the rate of 2% annually,
while our population is increasing at the rate of 2.35%. The increase in the
production of oilseeds is served primarily due to the increase in the area of major
oilseed crops such as groundnut, rapeseed and mustard, linseed, sesame and
castor etc. Increase in the population and improvement in the standard of living
of the people have resulted in greater demand for edible oils, which can not be
met only by increasing the area under oilseeds due to greater competition with
other crops. Thus increase in the productivity of oilseeds per unit area is viable
the only alternative to overcome the increasing demand of the edible oils in the
country. Currently to meet the demand of oils and fats, India is most importing
edible oils worth for Rs. 900 crores annually.

Oil seed crops are responsive to sulphur (Sudeep and Bhuttar, 2006).
About 1 kg S is required to produce one tone of oilseed. However, these crops
are grown in rainfed conditions and usually in marginal lands with little or no
application of sulphur containing fertilizers (Ghosh, 2000). Presently, sulphur
deficiency is widespread in Indian soils which may become more severe in near
future. Alluvial soils of Rajasthan, Bihar and Haryana, lateritic soils of West Bengal, vertisols of Gujarat and Karnataka etc have observed as the potential oilseeds growing belts in India, which suffers from sulphur deficiency. A balanced fertilizer management practice is, thus, imperative to mitigate the effect of sulphur deficiency and to break the barrier for the stagnated yield of oil seeds. The response of S application in oilseed crops is spectacular and ranges from 15 to 62 kg S/ha.

Plant breeding efforts have been directed towards increasing yield of the oil seed crop. During 1990-91 despite drought in several parts of the country, the total oil seed production was 18.46 million tones (Economic survey, 1991-92) and edible oil production was nearly 3.8 million tones (Hindu Agriculture survey, 1990). Although impressive gains have been made in respect of increase in productivity, it still does not match the requirements and the country had to import 525.8 thousand tones of edible oil costing Rs. 330 crores (Hindu Agriculture survey, 1990; Economic survey 1991-92). In its direction for self-sufficiency in edible oil, the ministry of Agriculture and Irrigation in supporting and organizing area expansion of oil seed crops such as ground nut, sesame, sunflower, mustard, niger, safflower, soybean and oil palm. The contribution of the three major oil seed crops of sesame, groundnut and sunflower was about 63%, 26% and 12% respectively to the total area of oil seed crops as recorded in 2003-04. Various measures are being taken to increase yield of oilseed crops with the provision of irrigation, quality, seeds, fertilizers and pesticides etc.

Production of oilseeds can be increased either by bringing more land under the cultivation or by increasing its productivity. Per capita land area, under oil seed production and for that matter, under any type of agriculture, is declining rapidly with the increase in demographic pressure, soil degradation, urbanization and change of agricultural land to non agricultural land use (Fertilizer Statistics, 2004). As the major reason for low production of oil seeds are dependent on constraints at ecosystem level and also constraints at farmer’s level, a proper understanding and analyzing the constrains on a holistic basis is the next important step. The constraints at ecosystem level are mostly related to
natural resources viz. soil, water and climatic, appropriate technology should be evolved which conserve the natural resource base rather than degrading it. There is very little scope for expansion of area exclusive under oilseed production. Therefore increasing the yield is the only feasible option.

The growing world population will require higher agriculture output and thus more intensive crop production. Higher yields will, in turn require more agricultural inputs. Several recent studies have suggested that the expected continual yield and production increments are likely to require increases in the use of fertilizers, too. In industrialized countries, it appears however, that yield levels have plateaued during the past ten years. Because of the already balanced application rates and improved efficiency, environmental concerns, reductions of farm support programs and trade liberalization policies, fertilizer use in developed countries is likely to continue to go down following a trend since the mid eighties (IFA, 2003 and Peltonen et al., 2003). Over the last 30 years there has been a positive correlation between plant production and fertilizer use in developing countries and this trend will expected to continue further. In general, more efficient use of fertilizers through improved timing, split applications, site specific management, crop rotation and management, soil sampling and testing etc. can evolve a better nutrient management system to obtain higher yields with the same amount or even less fertilizers (Robert, 2006, 2007 ; Muurinan et al., 2006). Availability of right type of fertilizer at the right time and right place is very important for expansion of balanced used of fertilizers even localized shortages of certain fertilizers have been found to frequently occur during the periods of peak demand, (Pasricha, 2004). Hardly 30-40% of the nutrients supplied through fertilizers are utilized by the crops and the remaining are lost through various pathways or retained in the soil (Singh et al., 2006). The declining efficiency of fertilizers is of great concern. In a country like India, where nearly 75% of the farmers operate small and marginal holdings and are resource poor, fertilizer nutrient wastage arising from inefficient use prove prohibitively expensive and thus can be ill afforded. Further, any inefficient use
of fertilizer nutrients can cause adverse effects on the environment, casting additional doubt on the long-term sustainability of oilseeds production.

In many countries authorities have initiated fertilizer management programmes regarding the use of both mineral fertilizers and the organic manures. This is done in order to sustain the soil nutrient status and nutrient input balance and at the same time minimize the risk of nutrient losses in the environment, particularly the water environment. Therefore, nutrient management issues related to the protection of environment have become one of the most important research areas to fertilizer technologists and agricultural scientists. To meet the requirements on sustainable agricultural and fertilizer use, raw material quality and environmental safety issues play a key role when new fertilizers are formulated and developed (Robert, 2006, 2007; Muurinan et al., 2006).

The thrust areas identified for increasing production of oilseeds during tenth plan are special production programme in areas at the tail end of the command irrigation system, diversification programme of rice-wheat system, convergence of oilseeds production programme with watershed development programme, intercropping of oil seeds with other crops and extension of these crops in selected regions of the various states for production. A productivity increase of about 60 percent in oil seeds is possible with the existing technology. Besides above, the thrust will be given to increase the seed replacement rate (SRR), promotion of proper and balanced mix of NPK and use of sulphur (Sudeep and Bhuttar, 2006), use of biofertilizers like rhizobium culture and phosphorus solubilizing bacteria (PSB) (Nisar Ahmad, 2005) popularization of IPM technologies and promotion of sprinkler sets. Involvement of private sectors for extension, production of seeds, supplying inputs and marketing support will also be promoted. Increasing availability of seeds by undertaking programmes for production of certified/quality seed will also include the crash programme for quality production of groundnut, soybean, mustard, sesame and mentha (pippermint).
Indian mustard (Brassica juncea (L) Czem & Coss) is the most important winter season (rabi) oilseed crop. Initially rapeseed mustard (Indian mustard) crop was considered too risky to commercialize, however, the farmers were growing them because of non-availability of suitable alternative suited to prevailing climatic conditions, cultured practices and available resources. Now farmers consider rapeseed mustard more remunerative and assured as any other crop. Indian mustard is an important commodity on the international oil seed market with a global production of around 32 Mt, it ranks second behind soybean with about 180 Mt (FAO, 2002). Major producers of mustard are China (10 Mt), the European Union (9 Mt), India (4 Mt) and Canada (3 Mt). The yield level varies considerably from less than 1 ton/ha in India to 4 tones/ha in Denmark and the Netherlands. The world average is 1.4 tones/ha, which is also the level achieved in China and Canada (International fertilizer correspondent No. 8). Indian mustard is traditionally grown in north-western plains of India. But now a days farmers in non traditional states viz. Maharastra, Karnataka, Tamilnadu and Andhra Pradesh are also taking interest towards cultivation of this owing to its better production and low cost of cultivation (Damodaram and Hegde, 1999). Indian mustard is nutritionally very rich and its oil content varies from 37-49 %. The seed and oil are used as a condiment in the preparation of pickles, flavouring curries and vegetables as well as for cooking and frying purposes, in manufacturing of industrial products like soap, paint, varnish, hair oil and medicines etc. The cake is mostly utilized as cattle feed and manure. The leaves of young plants sometimes serve the purpose of green vegetable. It is also used as green fodder for animals during lean period. In Haryana, Indian mustard is mainly grown in south-western parts of state where soils are light in texture and irrigation facilities are limited. Although the productivity of Haryana is highest in the country, yet it is far below the productivity of developed countries such as Germony (3364 kg/ha), France (3269 kg/ha), and Poland (2346 kg/ha) (Damodaram and Hegde, 2000 ; Hamlin et al., 2006 ; Garg et al., 2006).

Sesame (Sesamum indicum L.) though to have originated in Africa, is considered to be the oldest oilseed crop known to man and is now grown in
many parts of the world including the United States of America. Sesame seed is
an important source of edible oil and is also widely used as a spice. The seed
contains 50-60% oil, which has excellent stability due to the presence of natural
antioxidants such as sesamolin, sesamin and sesamol (Brar and Ahuja, 1979;
Lavanya et al., 2006). Sesame is an important edible oilseed crop. The seed
contains all essential amino acids and fatty acids and is a good source of vitamins
(pantothenic acid and vitamin E) and minerals such as calcium (1450 mg/g)
and phosphorus (570 mg/100 g) and the seed cake is also an important
nutritious livestock feed. (Balasubramaniyam and Palaniappan, 2001; Laxmi
Prayaga et al., 2005; Lavanya et al., 2006). But unfortunately, its use as an oilseed
crop has not been explored fully in our Country (Hatam and Abbasi, 1994). As a
medicinal plant, traditional uses of sesame have included limited application as a
demulcent and emollient and the use of sesame oil as a laxative and tonic.
Sesame oil is also used as a pharmaceutic solvent, and sesamolin is also used as a
synergist for pyrethrum insecticides. The fatty acid composition of sesame oil
varies considerably among the different cultivars worldwide (Yermanos et al.,
1972; Brar, 1982). After oil extraction, the remaining meal contains 35-50% protein,
and is rich in tryptophan and methionine. Seeds with hulls are rich in
calcium (1.3%) and provide a valuable source of minerals (Johnson et al., 1979).
The addition of sesame to the high lysine meal of soybean produces a well
balanced animal feed. Since the oilseeds have remained untouched from the
recent breakthrough in agricultural technology leading to green revolution in the
country, therefore oilseeds research should aim at increased production and
stability in yield. Sesame occupies an important place in the oilseed scenario of
India. It is a delicate crop, hence require careful management. It is confined to
small farmers in semi-arid tropics on marginal and sub-marginal lands with poor
agronomic management resulting in low average yield. Seasame is grown over
an area of 4.8 Lakh ha with in Haryana and 17.34 Lakh ha production of about
7.3 Lakh tones with an average yield of 421 Kg/ha in India. The average
productivity of sesame is very low, (335 Kg/ha), which is mainly due to its
the industry has increased to such an extent that there are portions of Michyan where thousands of acres are planted with nothing else but peppermint (Lee et al., 2002 and Yogesh, 2006). It is a native of Europe which has also acclimatized in India and cultivated in different parts of U.P., Haryana, Himachal Pardesh and Jammu and Kashmir. The plant is used as stimulant, stomachic, carminative, nerine, anti diarrhoeal, as the essential oil bearing medicinal properties are isolated from leaves. Composition of oil is methyl acetate 20%, menthol 9.1%, menthons and hydrocarbon 15% (Lee et al., 2002 and Patra et al., 2006). Mentha sp. are used for the commercial production of menthol and mint oil. In India it is grown over 40,000 ha area and 6000 tones oil is obtained from the crop. The productivity is about 12 q/acre and oil obtained is 80 Kg/acre. A fertile soil and favourable rainfall conditions are most important factors for achievement of stable yields and good quality of peppermint (Patra et al., 2006). Mineral nutrition is factor that might have great influence on the yield, along with preserving or ever improving a quality of the raw material (Singh et al., 1989; Stepanovic, 1993; Piccagila et al., 1993; Zheljazkov et al., 2002; Patra et al., 2006). The essential oil in the leaves and flowers is used as a flavoring in sweets / candies, chewing gum, ice-cream etc and is antiseptic and strongly antibacterial, though it is toxic in large doses. When diluted it can be used as an inhalant and chest rub for respiratory infections.

Salinity is known to retard plant growth and development by decreasing the availability of water and nutrient to the plant, changes in photosynthesis, so sulphur and nitrogen metabolism and increase or decrease in various enzyme activity which alters the growth and development of oil seed plants. It is imperative to understand salt induced changes in each specific crop and the amelioration of stress effect by use of various combination of fertilizers.

A sustainable agricultural productivity with in the available land resources is needed to feed an ever increasing population. Salinity is one of the major causes of decrease in the agricultural acreage and crop productivity throughout the world. The problem is huge; almost one billion ha of land is
affected by soil salinity, which covers about 71% of the land area (Szeboles, 1994; Singh et al., 1997). Out of the 1.5 billion ha land that is cultivated, about 5% i.e. 77 million ha is salt affected. The problem of salinization of land is increasing primarily due to the bad agricultural practices. Irrigated land is particularly at more risk being salt affected. Despite its relatively smaller coverage, the irrigated agricultural land is estimated to produce one third of the world’s food (Munns, 2002). About 17.5 million ha out of total land area of 32.9 million ha in India is ‘waste land’ according to “National Wasteland Development Board”, out of which more than 12 million ha land area is salt affected. Sodic soil dominated wasteland areas are most extensive and constitute about 85% of the salt affected soil in India (see Dahiya et al., 2000).

In order to boost up the export potential and meet the international standard improvement in the oil seed quality and yield is the need of hour. Several research has shown that the nutrient management is the most critical input for enhancing the oil crop productivity as well as improving the quality of seed. (Zhao et al., 1993; Tomar et al., 1996). Due to decline in organic matter and micronutrients in intensive cultivation areas, a decline or stagnation in the productivity has been documented which persuade farmers for a further loading of chemical fertilizers (Anoymous, 2004). It has added serious environmental problems, such as groundwater pollution, eutrophication of streams and lakes, destruction of stratospheric ozen layer, green house effects and soil acidification etc. (Shoji and Gandeza, 1992; Shaviv and Mukkelsen, 1993; Singh, 1995; Singh et al., 1998; Prasad 1998, 1999, Saigusa, 1999; Prakasa Rao and Puttanna, 2000; Paramsivam et al., 2001).

The most significant alternative has been suggested as integrated plant nutrient system (IPNS), which adapts plant nutrition to a specific farming system and particular yield targets, the physical resource base, the available plant nutrient sources and the socio-economic background (Prasad, 1999). Use of farm yard manure (FYM) (Kumar and Yadav, 2003), biofertilizers (Sinha et al., 2002 a,b), co-compost of cattle manure and slow release fertilizers (SRFs) (see Saigusa
et al., 1999 and Padmaja et al., 2000) have been reported to be beneficial for sustainable productivity of oil crops in long term field experiments and have been suggested to be viable alternatives. The cost of production and applications of such alternatives to chemical fertilizers are still a challenge for its large-scale adaptation.

Biofertilizers can be a supplement to chemical fertilizers, however, wider acceptability of bio-fertilizers among the oilseeds farmers is constrained because of inconsistent responses and problems associated with the availability, transport, storage and handling. The production and distribution of different biofertilizers in the country can hardly meet the requirement of less than 10% of the cropped area. As there is no quality control for bio-fertilizers, the success rate at farmers level is further greatly reduced due to poor quality. There is need to bring biofertilizers under quality to ensure that inoculum used by the farmers should confirm to certain minimum standards. Use of Azotobactor and Azospirillum gave significant response in seed yield of mustard, safflower (DOR, AICRPO, 1995), and sesame (Rathore et al., 1997). Seed inoculation with phosphorus solubilizing microorganisms had beneficial effect in groundnut and sesame (Anonymous report, 1993; Nisar Ahamad, 2005).

Organic farming is an age-old practice based on organic manure and biopesticides, a combination of which has worked well to produce sufficient quantity of food for the population. However, in the 1950's the total food production in India was 55-60 million tones and the crop yield was between 300-700 kg/ha, which was during the early 70's, by introduction of hybrids/high yielding varieties, chemical fertilizers, pesticides and weedicides resulted in the green revolution, which fulfilled the demand for food considerably. Today the food production has crossed 200 million tones.

As per the latest census, the Indian population has crossed one billion and to feed this huge population, the food and edible oil production should increase proportionately. For achieving that a second green revolution is required. Organic farming can be the way for sustainable agriculture because it avoids the
use of chemical fertilizers, pesticides and weedicides, however, it is non-
imaginable for India and the world to produce the required quantity of food
without the use of chemical fertilizers. Evidence to this fact is that crop yields in
developed countries like Japan, USA and UK are quite high as compared to that
in India, which is due to the higher use of agrochemicals like fertilizers,
pesticides and weedicides. It is also true that the use of chemicals is packed with
unwanted gifts of pollution and other related problems and excess use of
agrochemicals can caused, air, water and food contamination resulting in health
hazards. To overcome this problem, some farmers in developed countries have
begun shifting to organic farming in a phased manner. Although the quantity of
yield is less, the developed countries have counteracted this problem by selling
organically grown food products at higher prices. To strengthen this system new
Agricultural Research stations have been set up in these countries to carry out
research on organic farming (Shanthaveerabhadraiah, 2002). The agricultural
scenario in India is quite different from that in the developed countries. Shortage
of nutrients and inadequacy of plant protection measures are the major
constraints. Hybrids and high yielding varieties demand more fertilizers for
better yields.

The nutrient requirement of oil crops is measured on its yield potentiality
and therefore in reality it is not possible to meet the heavy nutrient demand of
the crops through organic sources alone (USDA, 2006). Organic manures like
FYM, compost, green manure account to only 0.5-0.3-04 percent of NPK
(Shanthaveerabhadraiah, 2002). The nutrients in organic manure are released to
the crop very slowly and over a very long period of time. The organic manure
improves the physical, chemical and biological properties of the soil and also
provides micronutrients which are essential for plant growth particularly for
oilseed crops. In spite of realizing the importance of organic manure, shortage of
raw materials have prevented many farmers from using it in the proportion that
is recommended by the Agricultural University and state Department of
Agriculture. Post of the green revolution, farmers in India have opted for hybrids
and high oil yielding varieties. This has also necessitated farmers to take up chemical control methods because of their quick action (Ghosh 2005; USDA, 2006).

Integrated nutrient management (IPM) employ both organic and inorganic manuring to meet the nutrient requirements of the crop. In integrated nutrient management, compost, green manure, vermicompost, biofertilizers, crop residues, neem and other oil seed cakes, are given importance, while the integrated best management (IPM) employs cultural, biological and chemical methods. Priority is given to best-resistant varieties of crop. Since it is relatively new concept, organizations which advocate organic farming should take up INM and IPM to the farmers and impart training to them harvest to get maximum benefit (Roberts, 2006, 2007 and Muurinan et al., 2006).

Although this is negligible when compared to the quantity used in the developed countries, to overcome the pollution problems due to indiscriminate use of fertilizers and pesticides, a new approach is needed which is eco-friendly and cost effective and minimizes the ill effects of chemicals. A substantial improvement in fertility management can be expected from programming nutrient supply rates to fit the physiological requirements at different growth stages of plants and from simultaneously reducing nutrient losses as well as the cost bases for material, transportation, equipment and labor. Application of slow (control) release fertilizers can potentially contribute towards reaching these goals. Application of slow (control) release fertilizers, especially those containing nitrogen, reduce nutrient losses because at any one moment, only a small fraction of the total application is present in a readily leachable form (Nisar Ahmad, 2005; Girarde et al., 2005; Singh et al., 2006; Kavoos, 2007, Broschat and Moore, 2007). Similarly, volatilization losses of nitrogen are diminished. The improved efficiency of fertilizer use is economically beneficial, saves energy and reduces environmental pollution. However, since nutrient release from slow release fertilizer continues in the absence of plants toxic levels of salts can accumulate during a fallow period or, alternatively, leaching losses can be higher than with conventional fertilization with currently available application rates several fold
without a danger of salinity. Thus in addition to reduced nutrient losses
economic benefits can also be expected from savings in labour, transport cost and
equipment. On the negative side are the additional cost for controlling the
nutrient released and often a lower nutrient content per unit weight of the slow
release fertilizer (Oertli, 1980). Even though slow release fertilizers are excellent
alternatives to soluble fertilizers. Because nutrient are released at a slower rate
throughout the season, plants are able to take up most of the nutrients without
waste by leaching (Nisar Ahmad, 2005 ; Girarde et al., 2005 ; Singh et al., 2006 ;
Kavoos, 2007, Broschat and Moore, 2007). A slow release fertilizer is more
convenient, since less frequent application is required, fertilizer burn is not a
problem with SRF even at high rates of application, however it is still important
to follow application recommendations. SRF may be more expansive than
conventional soluble types but their benefits outweigh their disadvantages.
There are some drawbacks associated with their use, because the rate of release
may be dependent upon soil moisture and temperature, the availability of
nutrients may not be constant or predictable.

Internally the application of these fertilizers are is limited to certain
plants, such as horticultural plants, lawns and high cash crops (Maynard and
Lorenz, 1979). However, in Japan slow release fertilizers are extensively applied
to many crops and are called 'Environment friendly fertilizers' and have been
tested with a large number of crop plants such as rice, soybean, sorghum, leafy
vegetables etc. (see Saigusa,1999; Robert, 2006; Wigena et al., 2007).

Now a days there is urgent need to produce slow release fertilizers based
on endogenous degradable non-toxic support matrix in place of commercial
beads to reduce the cost of production and to use especially in the developing
countries. It is expected that a sustained availability of S and N fertilizers will
result in the increased productivity and oil content of these oil seed crops
(Robert, 2006, 2007 and Muurinan et al., 2006). The sustained availability of the
nutrients by a single basal application can be obtained using biodegradable, non-
toxic, low cost organic waste based slow (control) release fertilizers. This work is
planned to develop new generation, eco-friendly, low cost slow(control) release fertilizers suited for high productivity, yield and oil quality of three major oil producing crops grown world wide including India and cover a large agricultural land in Haryana.

Keeping the above perspective in view the following specific objectives were planned for the present study.

1. Assessment of the appropriate nutrient requirements for three important oil crops i.e. *Brassica juncea* L. *Sesamum indicum* L., and *Mentha piperita* L. in laboratory/field conditions.

2. Development of slow release fertilizers containing best performing nutrients for the three crops under the study.

3. Estimation of rate of availability of the released ammonium and sulphate from the slow release fertilizers in wet soil in laboratory conditions.

4. Study of the availability of most abundant nutrient in soil during the application of slow release fertilizers in field/pot experiments and its effect on the soil properties.

5. Estimation of growth and productivity of Indian mustard, sesame and mentha applied with selected slow release fertilizers developed during this study.

6. Determination of oil quality of crops applied with selected slow release fertilizers.