Groundnut Cultivation: A Novel Approach using Organic Input

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Abstract— *The groundnut or peanut is one of the important legume crops of our world, produced over an area of 5.4 million ha and production of 5.43 million tones with a productivity 910 kg/ha. High profitability along with sustainability can be attained in groundnut with proper fertility management and by organic farm practices. In the recent years organic farming has gained significant importance by supporting sustainable crop production and due to its eco-friendly benefits. Organic farming system in groundnut emphasis the use of vermi-compost, FYM along with other organic amendments like bio-fertilizers, bio-pesticides etc. and hence paving way for production of organic and healthy peanuts.*

Keywords— bio-fertilizers, organic peanuts, bio control-agents, disease management.

Papers Highlights:

- *Significance of cultivation of groundnut using organic inputs.*
- *Role of bio-fertilizers in groundnut cultivation.*
- *Use of organic manures in producing healthy peanuts.*
- *Pest and disease management in groundnut using bio-control agents.*

I. INTRODUCTION

The groundnut or peanut (*Arachis hypogea*) is one of the most important legume crop of tropical and sub-tropical countries belonging to the family legume. It acts as a rich source of protein constituting 22-30% and 44 to 56% edible oil (Savage J *et al*. 1994). It is mainly used for oil extraction but due to presence of high content of protein (22 %), carbohydrates (10 %), minerals (3%), niacin (17 mg/100g) and vitamin B, groundnut possess high food value and hence consumed directly (Rajagopal *et al*. 2000). Because of its significance, a shift in cultivation practices of groundnut from conventional methods to organic methods is going to pave way for a bigger change. It helps in ensuring production of high quality seeds with increased protein and oil content.

FIGURE 1: Ground nut (*Arachhis hypongea)* plant.

Organic farming is a type of farming system where the use of synthetic fertilizers, growth regulators, pesticides and livestock feed additives is completely or partially avoided. The concept of organic farming is based on the principle of environmental, social and economic sustainability (S.K.Yadav *et al*.2013). Significant characteristics include protection of long-term fertility of soils by balancing amount of organic matter in the soil, maintaining biological life in the soil, careful use of farm equipments, ensuring nitrogen availability through the use of legumes and biological nitrogen fixation, recycling of organic materials including crop residues and livestock wastes and weed, disease and pest control using crop rotations, natural predators, diversity, organic manuring, and resistant varieties (S.K.Yadav.*et al*.2013).

Organic production of groundnut depend entirely on farm management techniques that helps in maintaining the soil fertility by ensuring optimised microbial activity (Jagdish Reddy.2019).This include incorporation of FYM or vermicompost into soil, crop rotation, use of cover crops, cultivation of green manure crops and using organically accepted fertilizers and pesticides that flourish the soil with nutrients and protect plants from pest and diseases (Jagdish Reddy.2019). Within some years, use of organic manures in groundnut production is going to be an inevitable process since it improves the physical, biological and chemical properties of soil along with increased water holding capacity and rise in crop productivity.

Organic manure supplied to the soil during production of groundnut mainly includes green manure, neem cake, enriched compost and vermicompost. This ensures the health of plant and hence the crop yield. Seed treatment in organic farming is done using bio-fertilizers and bio-pesticides such as Rhizobium, PSB, and Trichoderma Harzianum

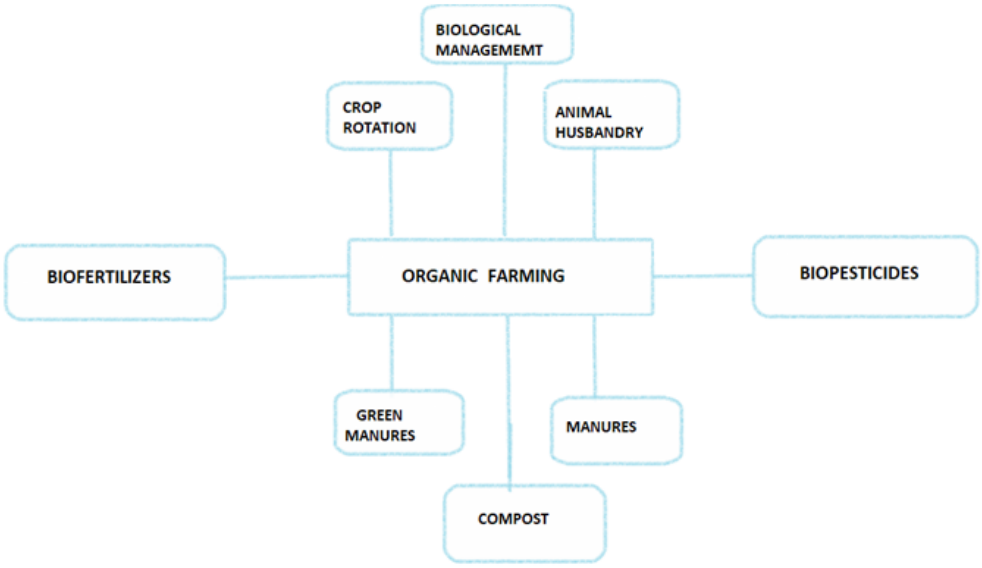

FIGURE 2: Organic Farming

II. WHY ORGANIC PEANUTS ARE RECOMMENDED?

Organic peanuts are rich source of vitamins and minerals .They are important source of manganese. It supplies phosphorous, magnesuim, vitamin E and niacin (Vitamin B3) to the consumers. Organic peanuts acts as small protein enriched capsules which are healthy and affordable. They are mostly recommended as healthy snacks and widely consumed as a part of weight-loss lunch (Reddy *et al* 2019).

III. BIOFERTILIZERS APPROACH TOWARDS GROUNDNUT PRODUCTION.

India is one of the largest consumers of chemical fertilizers due to practice of intensive farming system. The use of chemical fertilizers has doubled in the last two decades that resulted in increasing cost of fertilizers and environmental degradation. Hence, a switch to bio-fertilizers can bring hopes for many countries both environmentally and economically (Gupta *et al*. 2003).

The bio-fertilizers act as source of microbial inoculates that can solve the problem of high cost of chemical fertilizers and their effect on our Eco-system (Gupta *et al* 2003). The uses of bio-fertilizers are considered as a long term sustainable practice. In agriculture ecosystem microorganisms play a vital role in fixing/mobilizing/recycling nutrients. These microorganisms are naturally present in the soil but in a very less amount. So in order to ensure soil health we should provide the soil with sufficient amount of microbes or else ensure their population is maintained. To increase the crop yield desired

microbes are isolated, artificially cultured and mixed with suitable carriers and incorporated into the soil. These are called bio-fertilizers or microbial inoculates. Bio-fertilizers used in groundnut production include *cyanobacteria, acerbate, spiritualism, phosphate solubility microorganisms, carbuncular haemorrhagic, plant growth promoting cyanobacteria etc* (partisanship.2017).

In contrast to chemical fertilizers, bio-fertilizers are receiving attention and recognition from scientists because the microbial inoculates (including e.g. Rhizome and mycorrhizal fungal inoculants) introduced into soil or plant culture enhance plant productivity directly or indirectly (Mahdi,1992).Application of *Rhizobium and phosphobacterium* helps in achieving maximum shoot length, high number of branches per plant and leaf area index that resulted in high dry matter production (Chetti *et al.* 1995).

These bio-fertilizers contain living cells of nitrogen fixing organisms, phosphate mobilizing or fixing organism and phosphate mobilizers or fixers that helps in promoting plant growth by providing them with sufficient plant nutrients (Nisan subdivide.2017).

Generally in groundnut, seed treatment is done by mixing of seeds with bio-fertilizers in a plastic container since groundnut seeds are bigger as compared to other crop seeds. Through FYM, fertilizers can be provided by mixing them both and applying them in set furrow after which seeds are sown and irrigation is providing (partisanship 2017). Practice of fertigation provides many benefits including increased crop productivity and quality, efficient use of resources and environmental safety due to its role in reducing leaching of nutrients. Fertigation is practiced in groundnut cultivation in which liquid bio-fertilizers are diluted properly and applied in irrigation channel to spread uniformly. This helps in maintaining viability of cells (kisansuvidha.2017).

IV. ORGANIC MANURES AND THEIR SIGNIFICANCE IN GROUNDNUT CULTIVATION

Organic manures are mainly used for supplying plant nutrients in an efficient way along with improved soil conditions(Muhammad Ibrahim *et al.*2008).Organic manure has a strong positive impact on improving soil physical, chemical and biological properties and on increasing crop productivity. There are various studies suggesting that use of organic manures for a long time improved plant growth significantly (Muhammad Ibrahim *et al* 2008). FYM is a valuable organic fertilizer that helps in maintaining soil fertility (Järvan *et al.*2017). Suryanarayana Reddy in 1991 have reported that application of FYM has increased shelling percentage by 10%, 100 kernel weight by 32%, number of pod and pod yield in groundnut crop (P.Veeramani *et al.2011*). FYM not just act as a source of nutrient but also improves soil physical conditions that help in producing higher yield (Jagdev and Singh, 2000). According to the report of Balasubramanian and Palaniappan (1994), production increased in groundnut due to application of FYM along with microbial inoculants. FYM makes nutrients readily available to the plants by stimulating microbial activities in the soil(Dharma 1996). In groundnut production, incorporation of FYM in combination with poultry manure helps in increasing post-harvest soil organic carbon and calcium content in the soil (Das *et al.*1992). Fertilization with FYM in groundnut has reported increased kernel yield, highest dry matter accumulation, and oil content (Ahmed *et al*.1997). FYM application resulted in increased release of macro and micro nutrients that in turn increased dry matter production in groundnut (Dosani *et al* 1999). It also helps in avoiding potassium depletion in soil, maintaining positive potassium balance and increased availability of phosphorous (Akbari *et al*. 2002).

Poultry manure plays a significant role in organic farming due to its ability to enhance soil microbial activity, soil carbon, nitrogen content and porosity. Availability of macro (N, P, K, Ca, Mg, S) and micro-nutrients (Cu, Fe, Mn, B) in soil can be ensured with the application of poultry manure which act as a cheap source for these nutrients (P. Veeramani *et al* 2011). Poultry manure is important to maintain optimum physical condition of soil and for healthy plant growth (Rahman, 2004). In groundnut production, application of poultry manure improves number of pod per plant, pod yield and haulm yield (Subrahmaniyan *et al* 1999). Presence of higher proportion of nitrogen, phosphorous, potassium and other essential nutrients makes poultry manure an excellent choice as organic manure. Poultry manures works better than mineral fertilizers because it adds organic matter to the soil that helps in improving soil structure, aeration, soil porosity, and moisture holding capacity of soil and water infiltration (Deksissa. *et al* 2008).

Panchagavya is an organic product prepared using by-products of cow like cowdung , cow urine, cow milk, cow ghee ,cow curd and other ingredients (Gauthami.R *et al* 2014). Panchagavya helps in improving biological efficacy of crop plants (Nataraja 2002). In groundnut production, application of panchagavya along with neem leaf extract during branching and

flowering helps in enhancing nutrient content, nutrient uptake, plant physiological characters, dry matter accumulation, chlorophyll content and yield attributes (Kumawat *et al* 2009).

V. ORGANIC PEST CONTROL: SUBSTITUTE TO SYNTHETIC PESTICIDES

There are a large number of insect pests associated with groundnut. Many of them are economically important. One of the major yield constraints of groundnut is insect pests (M.P Ghewande *et al* 1997).In India more than one hundred species of insects are reported in groundnut (Amin 1988; Nandagopal 1992). However, not all of them cause economic losses. Optimum integration of pest control and pest surveillance could result in maximum benefits in production of groundnut (M.P Ghewande *et al* 1997).

Even though chemical pesticides proved to be helpful in reducing pest attacks, their excessive use has resulted in major environmental issues. Their uncontrolled use has led to deterioration of beneficial organisms present in the soil and also resulted in pesticide residual problems and development of pesticide resistance in pest population. Hence IPM acts as a better alternative for pest management by providing sustainable methods of pest control (M.P Ghewande *et al* 1997).

There are many predators and parasites with power to cause mortality in aphids like

Menochilus sexmaculatus Fab., Coccinella repanda Thumbeg. var. transversalis Fab., C. maculata, C. septempunnctata, Brumus suturalis Fab and *the syrphids, Ischiodon scutellans Fab. and I. javan. Anthocoris sp. and Chrysopa carnea (chrisopidae*) (Amin 1988; Bakhetia and Sidhu 1976; Upadhyay and Vyas 1987).

There are some spiders and lygacied bugs that prey on jassids in groundnut but not cause major change in their population (Amin 1988).For jassids such as *E. kerri Pruthi, B. hortensis and Exitianus taeniaticeps (Kirchbaum)* there are preys belonging to species *Crassopalpus*, Empididae, Diptera (M.P Ghewande *et al* 1997).

According to the report from Junagadh , three species belonging to Heteroptera and four belonging to Salticidae (Spiders) act as predators of *c.indicus* (Nandagopal 1992).

The larvae of leaf miners can be controlled with the help of *Aspergillus flavus* which parasitize on them (Oblisami *et al* 1969).

Cultural control methods are integral part of pest management that include use of mulches, intercropping, crop rotation and other agronomic practices for control of pests.

Larvael population in groundnut can be controlled by inter cropping of groundnut with cowpea. *Pennisetum typhoidus* can also be inter-cropped with groundnut to achieve low incidence(20.8%) of leaf miner, resulting in higher income (Murali Baskaran and Thangavelu 1990). Foliage treatment of groundnut with 10% *P. typhoidus* leaf extract in water can reduce egg laying in leaf miner by 74%. (Murali Baskaran and Thangavelu 1990). Thrips can be controlled by sowing of crops at the onset of rainy season. According to the study conducted by Wightman and Amin at 1988, pest incidence can be reduced by 10% by practicing intercropping or multi-cropping of groundnut with cereals.

VI. ADVANCED DISEASE CONTROL METHODS IN GROUNDNUT

Discussion on replacement of synthetic fungicides has gained significance in the recent years due to the increasing price and environmental hazards caused by them. Apart from that, resistance developed by pathogen population against fungicides also possesses serious threat. Hence it is very important to provide an organic alternative to these problems (Ghewande *et al*. 1997).

Soil born pathogens act as one of the main reason for occurrence of diseases in groundnut. Among these, stem rot(collar rot) caused by *sclerotium rolfsii* plays major role. According to Mayee and Datar (1988) this disease can cause severe damage during any stage of the crop and can result in a yield loss of 25%. This can be controlled biologically through integrated pest management where combined application of *Rhizobium* and *Trichoderma harzinum* is applied. These microbial agents along with disease resistance also promote plant growth (S.Ganeshan *et al*. 2006).

Ghewande 1989; McDonald *et al*. 1985; Subrahmanyan *et al* 1990 had found that the Early and late leaf spot pathogens can be controlled using fungus *Dicyma pulvinata* (*Hansfordia pulvinata*) and *Verticillum lecanii* with their parasitic nature.Control of *P.arachidis* pathogen that causes rust on peanut can be done with the help of bio-agents like *Acromonium persicinum, A. salmonaum, Darluca filum, Eudarluca caricis, Tuberculina costaricana, Penicillium islandicum and V.*

*lecanii.s (*Ghewande 1990b; Sharma and Agarwal 1988; Sharma et al. 1990; Subrahmanyan and McDonald 1987; Yadav *et al*. 1987*).*

Rust control at a rate of 66% is done with the help of spray application of cultural filtrates of both *P. islandicum* and *V. lecanii.* Size and number of lesions caused due to late leaf spot can be reduced with the help *V.lecanii* under field conditions (Ghewande 1989 and 1990).

Glucan isolated from, Acremonium obclavatum, is used to protect groundnut against the rust disease. Treated leaves showed a huge reduction in development of rust disease with increased amount of salicylic acid and chitinase. (Sathiyabama.M,Balasubramanian.R *et al* 2018).

The cultural methods involved in reduction of rust and leaf spot diseases in groundnut involves crop rotation, removal of volunteer groundnut plants, and removal of infected crop debris(McDonald and Raheja 1980; Subrahmanyan and McDonald 1983).One more method that could help in reducing incidence of leaf spot and rust is by practising early sowing of groundnut. (Ghewande et al. 1986; Kodmelwer and Ingle 1989; Siddaramaiah et al. 1980; Smith and Littrell, 1980).

Plant population density alternation is proved to be an effective method in reducing foliar disease severity (Ghewande *et al*.1986; Kodmelwer and Ingle 1989). Intercropping is one of the most successful methods in controlling rust and leaf spot diseases. Intercropping of groundnut with cowpea, sorghum, pearl millet and black gram is commonly practiced inorder to control these diseases. Pigeon pea and castor can also be used as successful intercrops for controlling rust and leaf spot (Ghewande *et al*.1993; Ghewande *et al*. 1986).

Aspergillus crown rot in groundnut can be controlled by practicing crop rotation of groundnut with other plants like wheat and gram (Sathiyanarayanamurthy *et al*. 1988).

A change in occurrence of root rot caused by *M.phaseolina* was observed when the groundnuts were planted with a spacing of 30 cm between them in a row as compared to the spacing of 45 cm or 60cm (Sharma 1982).

Control method of stem rot includes early sowing of crop and reducing of space between the plants (Ghewande 1983).Stem rot can be controlled effectively with the help of practices such as preventing organic matter development, burial of organic matter before planting , field sanitization etc (Garren 1964). Proportion of plants infested with bud necrosis can be reduced by increasing the plant density (Reddy *et al*.1983). Other than this, intercropping with pearl millet and early sowing can also diminish the chance of bud necrosis occurrence (Ghanekar 1980).

Soyabean, cowpea and navy bean serve as inoculum of peanut mottle virus hence it is recommended to cultivate groundnut away from these plants (Demski and Kuhn 1983).Clump disease caused by peanut clump virus in groundnut that result in stunted plant growth and many other symptoms can be controlled by growing groundnut during rabi season (Reddy 1988).

Diseases caused due to nematodes can result in huge loss in the groundnut farming, so it is very important to ensure their effective management. This can be done with the use of oil cakes, neem cakes, and other organic amendments along with deep ploughing during summer months (D.J. Patel, personal communication).Root-knot nematode species like M. arenaria are controlled by practicing crop rotation of groundnut with cereals and other crops like sesamum, castor and cotton (Rodriguez–Kabana and Morgan–Jones 1987; Rodriguez Kabana et al. 1991).

Peanut Stripe Virus (PStV) can be a serious threat to groundnut, if not managed properly. It can result in stunted plant growth and low pod yield. Cultural control practices of PStV include mixed cropping, inter cropping, use of non-legume plants for rotation, removal of weed host from the field, field sanitization, roughing, and burning down of infected plants. Hosts of PStV virus like legumes and sesamum should not be cultivated near groundnut (Singh *et al*. 1993).

VII. CONCLUSION

From the study, i conclude that, organic production of groundnut support sustainability and environmental well-being by reducing the input of synthetic pesticides and insecticides in the field. Use of naturally available inputs such as bio fertilizers and other organic matters are involved in improving the soil health and ensures maximum yield.

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