**GREEN MANURE INTERCROPPING IN COTTON- A REVIEW**

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**ABSTRACT**

Cotton is a wide spaced and initial slow growing crop and therefore, offers scope for intercropping green manure. Intercropping and incorporation of green manure supply nitrogen and increase the nutrient use efficiency and yield of cotton. Incorporation of leguminous green manure crops viz., sunnhemp, dhaincha, mung etc., has the beneficial effect on soil fertility also. As cotton and plant protection are inseparable, green manure intercrop has to serve as plant protectant too. More importance has to be attached for such green manures. With all these ideas in view, an attempt has been made to review the research work done on intercropping green manures and unconventional green manures on the growth, nutrient contribution, pest control and yield of cotton.

Cotton (Gossypium spp.), considered as “King of fibre” and “white gold”, is one of the most important commercial crops grown in as much as 80 countries in the world occupying 33 m. ha. In the year 2000-01, cotton has been cultivated in our country over an area of 9 m. ha with a production of 145 lakh bales. The productivity has been arrived at 276 kg ha\(^{-1}\) (Mayee et al., 2002), which is very low as compared to the world average of 550 kg ha\(^{-1}\) (Gopalaswamy et al., 2000).

Chemical agriculture is witnessed now with an eye on maximum output at the cost of input efficiency as a result of which cultivation is not sustainable (Ladha, 1995). The annual rate of growth in food grain production drops as the years pass by and it is mainly attributed to too much dependence on inorganic fertilizers and that too high analysis fertilizer. The soil is mined out with more depletion of nutrients. Soil fertility necessary for sustainable crop production may be maintained by a judicious combination of organic manures and inorganic fertilizers. There are different sources of organic sources which could have similar impact like FYM as suggested by Chittapur and Shenoy (1998) who reported that under limited supply of FYM, enriched FYM products or other cheap sources viz., digested slurry, fly ash, green manuring, oil cakes, biofertilizers etc., hold promise. Green manuring is an age-old practice and even research on it has been for long. Green manures are neither cash crops nor food crops and this is yet another factor for green manures not becoming popular in the present day agriculture. Unlike in the past, the ‘bulkiness’ of green manures or for that matter of any other organic manure is a constraint in the present day agriculture. The opportunity cost of raising green manures is also less. Yet it has to be promoted due to several unfavorable effects caused by chemical agriculture cited clearly. Cotton is a slow growing crop initially and wide spaced and consequently vulnerable for weed infestation. Innovativeness should stretch even beyond intercropping green manures and optimization of their rows. Cotton and plant protection are inseparable. Therefore, the green manure that is considered as an intercrop in cotton has to serve as a plant protectant too. More importance has to be attached on such green manures.

**Cotton Vs pests**

Despite the largest area in the world, the cotton yield is abysmally low in India. It is the American bollworm that caused a loss of 380 crores in Punjab in 2001-02 and the major outbreak in Tamil Nadu during 2002-03 has been stem weevil. Poor rains, substandard seeds and pesticides are the other causes for low yield (Vikas Singhal, 2003). While
agriculture overall has reached stagnation as an aftermath of green revolution, cotton has been the worst hit. Cotton is grown on 5 per cent of the land in India but it consumes about 54 per cent of the pesticides in the country (Meena Menon, 2003). Thus the emphasis is on newer measures preferably by non-chemical, agronomic approaches for managing the pests. They have to build up beneficial insects or as an attractant of cotton pests or both.

**Cotton Vs nutrition status**

Cotton is a heavy feeder and needs supplementation of nutrients to sustain yield. Nutrients P, K, Ca, Mg, B and Zn have influence on fruiting efficiency, whereas N, S, Mo and Mn have equal influence on vegetative and reproductive growth. But all cotton growing area in India are very poor in organic carbon, poor in available P and medium to high in available K. Buildup of soil organic matter is useful. Despite application of recommended dose of fertilizers, yield drops in the absence of organic manuring (Chittapur and Shenoy, 1998).

Benefits of continuous manuring could be appreciated from long term studies. Two times increase in soil organic carbon and higher concentration of available nutrients was observed under continuous manuring with FYM over a period of 45 years in cotton-jowar rotation at Pune. The yield of cotton nearly doubled (Khaini and More, 1984).

**Green manuring**

The practice of green manuring by the farmers has been for ages and in China it goes back to 1134 B.C. (Joffee, 1955). Still earlier Pieters (1927) wrote that much is known of what goes in the soil when organic manure is added but much still remains to be learned. There are still processes within plants that we do not understand. From the past to the present findings, there is a research gain. Bouldin et al. (1988) reports showed the advances in green manuring research. They reported two N fractions. One, which decomposes rapidly, is named as ‘Fast N’ and the other named as ‘Slow N’. Fast N accounts for 50-80 per cent of total N. Thus a brief review of the past to till date indicates growing advantages of green manuring for incorporation in the crop husbandry.

Green manuring refers to addition of green plant tissue to soil. It is incorporated to increase organic matter content, maintain soil structure, reduce loss of nutrients particularly N, provide a source of N for the succeeding crop and reduce soil erosion and thereby increase the production of crops (Greenland et al., 1979). It is a convenient mean to furnish higher amount of nitrogen to the beneficiary crops than any other system of organic manuring (Sharma et al., 2000). Advantages go beyond what are cited. *Heliothis* populations were much higher on sesame intersown in cotton (Laster and Furr, 1972). Weaver et al. (1994) observed the use of *Tagetas minuta* on controlling Mexican bean weevils.

**Difficulties in green manuring**

Incorporation of 5-8 t ha⁻¹ of wet biomass with given animal draft power and traditional implements is practically difficult on a large scale (Pandey and Morris, 1983). The farmers are reluctant to use their land, water and other inputs for raising a crop exclusively for green manuring prior to rice (Ali and Narsica, 1993; Kundu et al., 1993). Inducing the farmers to set apart six to eight weeks exclusively for a green manure with no direct benefit and revenue may not be possible in intensive cropping system (Abrol and Palaniappan, 1988; Palaniappan and Siddeswaran, 1999). Inadequate availability of quality seeds of preferred green manure species is another constraint (Abrol and Palaniappan, 1988; Becker et al., 1988; Palaniappan and Siddeswaran, 1999). The affordable price of N fertilizers, their ease of application and their
predictable nutrient supply stand in the way of promising green manures (Mathias Becker, 1996; Peoples et al., 1988). The focus of scientists is, therefore, on wider adoption of green manuring technology by evolving a suitable cropping system for fitting green manures without sacrificing any of the economic crops thereof (Palaniappan and Siddeswaran, 1999).

**Intercropping**

To get the interspace fully utilized, derive additional returns and contribute and confer benefits to the associate component, intercropping is recommended. There has to be a minimum duration difference of 25 per cent to get yield advantages. There may be allelopathic effect or annidation in space. To assess competition and yield advantages, various functions such as land equivalent ratio, relative crowding coefficient, aggressivity, competition index could be used (Palaniappan, 1985).

Cotton is slow growing in the early stages and is planted in wide rows. Hence potential for intercropping in it is more (Palaniappan, 1985). Cotton being a long duration crop permits green manuring with intercrops which would not be possible in other crops maturing within 100-120 days (Chittapur and Shenoy, 1998).

**Influence of intercrops on cotton**

Intercrops viz., mung and cowpea reduced the growth (plant height) of cotton and had a salutary effect to arrest the excess vegetative growth that occurred with the onset of rains. By restricting rank growth, intercrops aided fruiting and facilitated labour mobility in cotton. Thus competitiveness led to complimentarity (Kairon and Avtar Singh, 1972). Intercropping of sesameum and sunflower had suppressive effect on the growth of cotton as measured by the height of plants. They affected the boll production in view of their higher growth and vegetation. The intercrops longer duration has also been a contributory factor for their adverse effect on cotton. Boll weight also suffered due to these intercrops. Whereas, differing from the earlier report of Kairon and Avtar Singh (1972), the intercrops viz., greengram and cowpea did not affect the cotton growth with any significance. Greengram, in view of the short duration and growing habit, did not affect boll production also (Nagre, 1975).

Intercrops viz., moong, cowpea (fodder) and cowpea (green manure) had their own influence on the growth and development of associate cotton. The intercrops suppressed the production of monopodial branches whereas the cotton height and sympodial branches remained unaffected due to cropping systems. Significantly more number of bolls was produced under sole cotton and cotton + cowpea (green manure). Boll production had a set back with cotton + Greengram due to longer duration of green gram for grain purpose (Rao, 1982).

In a cropping system study made at Agricultural Research Station, Arhabavi on a medium black soil under irrigated condition, greengram, cowpea, soybean, onion and chilli were tested as intercrops in AH 107 cotton. Cowpea and soybean by their initial fast growth and smothering effect affected cotton boll production and seed cotton per plant. Onion raised in as many as 7 rows in between cotton rows planted with altered geometry of 150 cm x 15 cm, did not affect the cotton growth (height), open bolls per plant and seed cotton yield per plant. In fact these two yield attributes were sizably higher with onion intercropping as compared to sole cotton (Ramesh Babu, 1998).

In rainfed vertisols of Agricultural Research Station, Kovilpatti black gram and cluster bean as intercrops were observed to compete with cotton affecting bolls per plant and so also boll weight. In a three year study at
Akola, Wankhade et al. (2000) reported that intercrops viz., green gram, black gram and soybean did not affect the cotton height and so also sympodial branches. Dry matter per plant was more reduced with soybean. Numbers of bolls per plant and seed cotton yield/plant were much reduced with soybean. Thus the influences of intercrops were inconsistent and long duration crops such as sesame, sunflower were found quite incompatible. Many literatures reveal soybean, though it is a grain legume, has suppressive effect. The prevailing rainfall, growth and canopy cover of intercrops and their duration require collective examination for intercropping in cotton. Even the pest incidence could affect plant stand and alter performance of individual plants. Due to jassid menace in the first year of study, Tomar et al. (1994) observed reduction in plant stand. As a result, intra-cotton competition was less in cotton raised with different intercrops. The number of bolls per plant was more because of reduced plant population. Thus, the added crop to the primary crop (cotton) increased the complexity of an ecosystem.

**Intercrops, seed cotton yield and return**

In earlier years, mixed cropping was in vogue. Ducker and Hoze (1948) reported reduced yield of cotton when grown as a mixture. Yegnanarayana Iyer (1950) listed 22 crops, which lend themselves for cultivation along with cotton. Cotton inter sown in groundnut had no yield reduction as compared to sole cotton in two out of three years. But the return due to cotton + groundnut mixed cropping was promising as compared to sole cotton (Dhananjaya Rao and Dharma Rao, 1961). Similar was the report of Divekar and Kurtakoti (1961). Cotton + mung at 1:1 ratio resulted in nominal reduction in cotton yield but an yield of 462 kg/ha of mung was obtained due to intercropping. The wheat that followed cotton was also benefited. But intercropping of cotton with cowpea in different proportions did not prove beneficial under grain purpose cultivation (Sucha Singh and Rajender Singh, 1973).

Bavale and Vyahalkar (1981) observed that intercropping of legume significantly reduced the yield of seed cotton significantly. However urd as an intercrop did affect the seed cotton yield only very marginally by 3 per cent but gave an extra yield of 280 kg ha⁻¹ of urd and gave the highest monetary return. Mung reduced the seed cotton yield, while cowpea raised as fodder and cowpea raised and incorporated in situ did not affect the seed cotton yield. Monetary returns were, however, more with cotton + mung as compared to sole cotton (Rao, 1982). Intercropping of cotton with legumes such as greengram, black gram and groundnut as well as non-legumes such as foxtail millet, maize, chilli, onion etc., have been found to be profitable in the central and southern cotton zones. Short duration greengram and black gram gave the best results with 5-6 q of pulse per ha maintaining the cotton yield at the same time (Basu, 1985). Soybean and cowpea as intercrops suppressed the seed cotton yield, while onion enhanced the seed cotton yield and also seed cotton yield equivalent (Ramesh Babu, 1998). Sole cotton yield was higher in both the years of study as compared to intercropped cotton. The reduction in seed cotton yield (rainfed) was 7.9 and 10.3 per cent in black gram and 13 and 13.9 per cent in cluster bean during 1993-94 and 1994-95, respectively (Solaiappan et al., 1999). Chellamuthu and Ramaswami (2000) reported that cowpea and black gram as intercrops increased the seed cotton yield, while greengram and soybean were not so as far as base crop yield was concerned.

Thus from the far distant years of study to recent ones, it is seen that many grain legumes did not affect the principal (cotton)
crop yield (if at all only slightly) and overall returns were found higher. The point of observation of this review is that with proper choice of a component, cotton yield might not be affected. But with green manure intercropping with far higher duration difference, the expected benefits might be still higher, which are now reviewed hereunder.

**Intercropping of green manure in cotton**

**Effect on growth and yield of cotton:** Cotton, having wider spacing in between rows, makes feasible to grow an intercrop in it (Praveen Rao, 1991). Cotton being a long duration crop provides an opportunity for *in situ* green manuring during growing period (Chittapur and Shenoy, 1998). To start, with green manures effect on the associate cotton growth and yield are reviewed hereunder followed by their effect on soil fertility, pest and weed control on the principle crop.

More than five decades back Mirchandani (1950) reported yield advantage to the tune of 15-20 per cent in cotton due to intercropping and *in situ* incorporation of guar or sunnhemp as observed from the studies on the left bank of river Indus. The standing cotton receiving guar incorporation had better growth. Height and number of bolls were increased. There was an economic gain also due to these green manures intercropping. Whereas, the short growing season of cotton in the right bank did not favour intercropping green manures and there was yield decline in cotton due to guar or sunnhemp raised as intercrops.

Rao (1982) reported that leguminous crops like cowpea could be grown as intercrop in cotton for green manure purpose. The cowpea for fodder purpose, on the other hand, benefits the associate cotton. The rate of decomposition of legumes intercropped and *in situ* incorporated in between cotton rows followed Lucerne > sunnhemp > cowpea > black Soya > horse gram > soybean > blackgram > FYM. The seed cotton yield varied in accordance with the decomposition rate and followed sunnhemp > horse gram > Lucerne > black Soya > FYM > blackgram > cowpea > soybean (Anonymous, 1990). Raising green manures in between cotton rows and *in situ* incorporation resulted in increased boll production and lint yield as compared to sole cotton. While cotton + horse gram gave 14.66 q of lint ha⁻¹, sole cotton produced 11.04 q and cotton + FYM 10 t ha⁻¹ yielded 12.82 q showing right choice of green manures could outweigh even FYM (Gidnavar et al., 1992). In a cotton + green manure intercropping study conducted at Coimbatore, all the four green manures tested *viz.*, sunnhemp, lucerne, cowpea and *clitoria* had manurial effect and increased the seed cotton yield. Though the yield difference did not exist among green manure sources, sunnhemp gave some higher cotton yield than other green manures (Subramanian et al., 1995).

There are reports of yield reduction in cotton due to intercropping of green manures. At Banswara, Central Zone, intercropping and *in situ* incorporation of greengram, cowpea and sunnhemp decreased the yield of cotton considerably, whereas, FYM at 5 t ha⁻¹ resulted in higher yield of kapas (AICIP, 1999). Recently Katkar et al. (2002) reported 15 % increase in cotton yield due to green manuring with sunnhemp. Thus from most of the studies, advantages of intercropping of green manures in cotton are seen. Few reasons such as short growing season of cotton, prolonging turning time might be detrimental.

**Improvements in soil fertility:** Studies on soil fertility due to intercropping of green manures in cotton are limited. Gidnavar et al. (1992) reported 0.079 to 0.088% total N at harvest of cotton due to intercropping of green manures such as sunnhemp, cowpea, horse gram and similar other four green manures as compared 0.061% in sole cotton. The P and K were also higher in green manure plots. The other
favourable contribution of green manuring was higher organic carbon (0.54 to 0.63%). In a study of in situ green manuring and phosphate fertilization to irrigated cotton, Satheeskumar (1999) observed increase in soil available nitrogen, phosphorus and potassium at later stages as compared to sole cotton.

Pest incidence in cotton: Heliothis populations were much higher on sesame intersown in cotton reducing its incidence in the latter (Laster and Furr, 1972). Suresh and Dason (1996) recorded lowest population of leaf hopper and bollworms in cotton intercropped with black gram, cluster bean or greengram. Cotton is damaged by about 135 pest species right from crop germination to final picking. The indeterminancy of cotton also facilitates continuous food supply and shelter to the pests. Varied adverse effects are noticed due to the use of pesticides in cotton (Jambhrunkar et al., 1998). They suggested inter alia intercropping as one of the agro techniques to minimize the pest incidence. One of the ways to check major damage due to pests is raising intercrops with aromatic odour. Pest outbreaks in cotton are believed to be less common in mixed stands, which can be explained by resource concentration hypothesis and natural enemies hypothesis. In a survey involving crop diversity approach, minimum population was recorded in cotton + cowpea in southern districts of Tamil Nadu state (Saminathan et al., 2002).

Lucerne in association with cotton could promote natural enemies. Parasitis of bollworm egg and larvae was more in cotton + sorghum intercropping. Increased plant diversity and transfer of natural enemies from intercrop to main crop led to reduction in pest population as observed in cotton hybrid intercropped with cowpea, soybean, groundnut, sorghum, chilli and lucerne (Mahabaleshwar Hegde et al., 2003). Pink bollworm incidence was significantly reduced when cotton was intercropped with maize (Kavitha et al., 2003).

Cotton + cowpea had maximum number of predators followed by cotton + greengram, cotton + soybean. Intercropping of cowpea and greengram could suppress the sucking pests (Mote et al., 2001). In Punjab alone, American boll worm attack destroyed 4.3 lakh bales of cotton valued at Rs.3.80 crores. In 2002-03 seasons, stem weevil incidence was widely prevalent in Tamil Nadu. Sometimes it destroys 70 to 80 per cent of the crop in the state in summer (Vikas Singhal, 2003).

A brief review thus, shows an added plant species to the primary crop could modify the incidence of pests. But most of the works are with grain legumes or oilseeds intercropping in cotton. There is little or no information on the exclusive effect of green manure intercrops vis-à-vis pests incidence in cotton. Crops like sesamum and conventional green manures as green manure intercrops may have their effect on pest reduction in cotton.

Weed incidence due to intercropping: Research information on intercropping of green manures in cotton with respect to weed incidence is scanty. There are, however, reports showing the influence of grain legumes as intercrops in checking the weeds in cotton. Cotton is slow growing in nature and widely spaced too. It creates suitable conditions for an increased weed competition in the crop (Kulandaivel et al., 2001). Weed population comprising of grasses, sedges and broad-leaved weeds were found to be significantly reduced under high density cotton and paired – row planting with blackgram as intercrop (Sankaran and Balasubramanian, 1982). Chatterjee and Mandal (1992) and Thakur (1994) have pointed out depressive effect on weed growth due to legume intercropping. Cotton + black gram and cotton + cluster bean had comparable effect to reduce the weed density and dry matter than sole cotton in rainfed vertisols. The depressive effect on weed growth was long with cluster bean in association with
its prolonged duration (Solaiappan and Chelliah, 1998). Cotton yields are reduced by 50-85% with unchecked weed growth or ineffective weed control. The crop is susceptible to competition from weeds from sowing to about 60 days when the canopy covers the inter-row space (Nalayini et al., 2002).

Thus it is clear that cotton, by virtue of its slow growing nature and in view of wider spacing followed, weed incidence in general is more. Addition of a crop – be it a grain legume or a green manure - would have a check on weeds.

**Cotton + intercrop row proportion**

The effect of intercropping unconventional green manures in cotton at different row proportions and incorporation timings. Studies on this line with reference to green manure intercropping with cotton at different row proportions are lacking. But such studies were undertaken with grain legume intercrops. They are reviewed hereunder.

Intercropping mung and cowpea in all row proportions had higher return over sole cotton. Cotton + mung at 1:1 ratio had given higher additional returns (Kairon and Avtar Singh, 1972). In a study of intercropping of cotton with grain legumes at Adilabad, simultaneous sowing of cotton and urd in the interspace gave higher monetary returns. At 1:2 ratios, the returns were less both with urd and mung. Sole cotton also fetched low returns thus indicating row proportions could alter the performance of components reflecting finally on the returns (Praveen Rao, 1991).

The performance of American cotton with companion legumes was studied for two years at Indore. Despite high annual rainfall of 964 mm which was mostly received during cropping season, component grain legumes depending upon the species and variety exerted varying influence on the principal crop, cotton. At 2:2 ratios, cotton with SS 2 soybean gave comparable yield as that of sole cotton. Intercrop gave additional yield of 459 kg ha⁻¹ in the first year and 676 kg ha⁻¹ in the next year. Whereas, JS 71-05 soybean variety, in view of its branching habit, suppressed the cotton performance securing low seed cotton yield at the same ratio of 2:2. Black gram at different row proportions either 1:1 or 2:1 did not suppress cotton with any significance. Greengram at 2:1 or 2:2 ratio secured comparable seed cotton yield ranging from 907 to 932 kg ha⁻¹ whereas at 1:1 ratio, the yield of cotton was reduced to 759 kg ha⁻¹. Thus not only the grain legume but also its variety and the row proportion alter the performance of the principal crop (Tomar et al., 1994).

In a study of cotton raised with three oilseed crops viz., sesame, groundnut and linseed and one grain legume, greengram, it was found that greengram, due to short duration and short stature, did not affect the seed cotton yield noticeably. The reduction of cotton yield was 11 per cent. Whereas, with sesame, regardless of row proportions, there was significant reduction in seed cotton yield and the monetary advantage was negative. Sesame two rows in between cotton had more suppressive effect than at one row. The seed cotton equivalent yield was 2408 kg ha⁻¹ with cotton + greengram at 1:2 ratio and it reduced to 2001 kg ha⁻¹ at 1:1 ratio. Increase in row proportion with greengram secured thus higher seed cotton equivalent yield indicating the need of optimum row proportion for higher yield and monetary advantage (Sarkar et al., 1995). All these studies were mainly with grain legumes or oilseeds standing in the field for a minimum period of not less than 75 days as in greengram. With groundnut, sesame, soybean the duration will be still higher. The duration difference will be far higher as green manures were there in the field for a maximum of 40 days only. The larger duration difference justifies well the need to go in for different proportions of cotton and green manures as compared to grain legumes and oilseeds reviewed above which stood in
the field till maturity thus having relatively less duration difference.

**Duration of green manure intercrops**

Research on green manure intercropping in cotton has not been intense. Studies on duration of green manures in cotton are particularly lacking. Therefore works on other crops are cited. Wet seeded rice was sown in rows alternating with dhaincha by using TNAU Rice cum greengram seeder. Since dhaincha has photo thermal sensitivity, height based incorporation was studied. Among different heights at which dhaincha was incorporated in between rice rows by using IRRI conoweeder, allowing dhaincha up to 40 cm and burying it *in situ* conferred advantages comparable to transplanted rice with basal incorporation of green manure at 6.25 t ha⁻¹ (Selvi, 2001).

*Crotalaria* grown for 45 DAS and incorporated before rice had 72 to 85 kg N turn over, while on 55 DAS, it was ranging from 78 to 89 kg ha⁻¹. Incorporation timing had effect on N contribution (Sanjay Sharma *et al.*, 2000). Dhaincha, guar, lobia and moong were grown as intercrops in sugarcane and turned under unduly late at 110 days duration. The number of shoots, millable cane, cane and gur yield were all reduced. On the other hand, when turned under at the age of 67 to 76 days, their influence on both cane and gur yields were more favourable (Mishra *et al.*, 1970). Thus, earliest opportunity time has to be struck for intercropping and *in situ* incorporation of green manures. Prolonging its duration unlike in sequential cropping may have adverse effect on the associate principal crop.

**Unconventional green manures**

Our focus on green manuring is for its diverse uses hereafter depending on the crop. In cotton, the emphasis of green manuring could be first for checking pests and weed with more importance for the former. Manurial effect has to be also accommodated. Sesame is one of the oldest oil crops known to mankind and is produced on a large scale in Latin America. Its *attractancy* to *Heliothis* species was tested by interplanting it in cotton. *Heliothis* population was much higher on sesame till it attained physiological maturity. Thereafter the pest switched over to cotton. The effective attractive period could be extended further into the season by later planting as suggested by Laster and Furr (1972).

Sesame intersown in cotton had suppressive effect more so in favourable rainfall years on the cotton height, branching, boll production, boll weight and finally on the yield (Nagre, 1975). Arjun Prasad *et al.* (1989) have, however, reported in contrast. From a three year study on deep block soil of Bellary, Karnataka state, they found intercropping mung and sesame had favourable effect on cotton yield producing 3063 and 3012 kg ha⁻¹, respectively. Whereas, cowpea, chillies and groundnut as intercrops affected cotton yields resulting in a yield of 2706, 2708 and 2845 over 2945 kg ha⁻¹ from pure crop of cotton. The trend has been consistent over the years. Thus sesame as a choice of green manure in cotton might be more scientific in view of its early removal and *attractancy* to pests. Marigold, *Tagetes spp*. could serve as useful intercrops in agriculture. Population of nematodes has been reduced by intercropping marigolds (Davide, 1979; Huang, 1984). Researchers have isolated several insecticidal compounds from *Tagetes* spp. Compounds extracted from the leaves and flowers of *T. minuta* are toxic to *Aedes aegypti* (L.) larvae (Maradufu *et al.*, 1978).

Weaver *et al.* (1994) made elaborate studies on the use of *Tagetes minuta* for controlling Mexican bean weevils. Therefore it is scientific and logical to fit it as a green manure in cotton more for its pest control besides to have beneficial effects as manure. Growing it in the interspace might also check weeds to
some extent. Given right choice of green manure with short stature and with larger duration difference, there might not be any compromise on cotton yield. A context analysis emphasize that cotton has to be dealt in an unique way with green manure intercropping not for manurial purpose alone as it is usually considered in other crops but its effect on pest and weed control should also receive at least equal attention if not more. Unconventional green manures might be the key as reviewed in contrast to conventional green manures, which could at best have manurial effect only. Since they could be grown only for short duration, finer tuning on its duration for incorporation and row proportions holds promising.

REFERENCES


