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Intercropping in Cotton for Self Sufficiency in Pulses and Oilseeds

GUEST COLUMN

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During the Bt cotton era, the area under cotton increased from 86 lakh ha in 2000-2001 to around 130 lakh ha in 2020-21. It is believed that some of this gain in area under cotton is at the expense of acreage under coarse cereals, pulses and oilseeds. It may be recalled that the Technology Mission on Oilseeds was launched by the Government of India in 1986 and this mission was rechristened as Integrated Scheme on Oilseeds, Pulses, Oilpalm and Maize (ISOPOM) in 1995-96. During 2007, the ISOPOM was merged with the National Food Security Mission (NFSM). The main objectives behind these schemes were to attain self sufficiency in edible oil and pulses. Despite gains from these schemes,the demand for pulses and oilseeds continue to out-strip domestic production. In the last few years, India imported around 3 million tonnes of pulses / annum. Similarly, our edible oil import bill is around 60 thousand crore rupees per year. Considering the current land use scenario, limits to the increase the net sown area and the market dynamics, there is hardly any possibility of a significant horizontal expansion of area under pulses and oilseeds in the country. Hence their production can be increased either by increasing yields or through some alternate measures for area expansion. One such avenue is the intercropping of pulses and oilseeds in between the rows of widely spaced, long duration crops of cotton.

Intercropping and its Benefits

The concept of intercropping in cotton is not new. Our ancestors cultivated cotton for hundreds of years but never raised it as a monocrop. Traditionally, rainfed cotton was mixed cropped with cereals, pulses and oilseed crops in order to shield them against the vagaries of nature and also to meet the diverse dietary needs. Indirectly,

such mixed cropping systems improved agro-biodiversity and soil, plant, animal and human health. In simple terms, intercropping is the practise of growing two or more crops in the same piece of land. In cotton based intercropping systems, the main (base) crop of cotton provides the main source of income and the intercrops that are planted in the vacant spaces between cotton rows provide extra monetary returns and a host of other benefits.

There are several variants of intercropping including mixed cropping (two or more crops are mixed and sown with no distinct row arrangement), row intercropping (where the base crop and intercrops are sown in distinct separate rows), strip intercropping (where cotton and other crops are cultivated in alternate strips of uniform width in the same field). Based on the proportion and pattern of planting main and intercrops, the intercropping systems are referred as alternate rows or paired rows, skip rows, additive series, etc. Several combinations such as 1:1, 2:1, 2:2, 4:2, and strips of 6:2, 8:2, and 10:2 are in vogue.

Intercropping was once a widely adopted practice in Asia, Latin America and Africa to enhance crop productivity by maximising resource use.However, the current cotton production systems encourage monoculture, replacing biodiversity with few cultivars having a narrow genetic diversity. Such systems are not sustainable in the long run. On the other hand, an efficient cotton based intercropping system has the potential to restore sustainability through enhanced crop diversification, efficient resource management and soil fertility build up. Intercropping systems exploit temporal complementarily, since the component crops meet their major demands on resources at different times during the crop season

Cotton Pulse Intercropping

Intercropping cotton with pulses is one way to attain self-sufficiency in pulses, improve soil fertility and to generate additional farm income. Cotton+pulse intercropping systems not only permit better utilisation of natural resources-light, heat, nutrients and water - but will also reduce pest incidence by enhancing biological control by harbouring natural enemies of cotton pests.

Cotton is a widely spaced crop and has a very slow growth during the initial 40-50 days. The inter-row spaces remain sub-optimally used during this phase. Slot duration pulses-greengram, black gram and cowpea - can profitably be intercropped in cotton. These intercrops are either grown as 1 or 2 rows between 2 rows of cotton crop whose proportion is not altered. Both normal and paired row configurations have been tried and found to be successful. Another variant, the strip cropping of cotton and pigeon pea is very common in Maharashtra where 2 rows of pigeon pea are raised after 6-8 rows of cotton. Even in the irrigated regions of North India, intercropping cotton with legumes like black gram was found more profitable than sole-cropping systems. After the introduction of Bt hybrids, this practice has been discontinued in many areas.

Studies from different locations across India over several years indicate that 200-600 kg/ha of yield from intercrop can easily be harvested without adversely affecting the main crop of cotton. Positive soil nitrogen balance was also observed in several cotton+ pulse intercropping studies. Summarised results of 60 on-farm demonstrations on intercropping, each with green gram and black gram, conducted in Aurangabad district, Maharashtra, during 2014-2016 are presented in Table 1.

Table 1: Yield and economics of demonstrations of cotton+pulse intercropping system in farmers' fields

System	Cotton yield (kg/ha)	Intercrop yield (kg/ha)	Gross returns (Rs/ha)
Sole cotton	1567	0	73050
Cotton+green gram intercropping	1490	627	99324
Cotton+black gram intercropping	1441	505	94098

Cotton Oilseed Intercropping

Cotton is both a fibre and an oilseed crop. Thus, the production of cotton seed oil also increased from 0.53 million tonnes in 2000 to 1.4 million tonnes in 2020. There has been a significant replacement of groundnut and soybean by Bt cotton in the states of Gujarat, Maharashtra, Andhra Pradesh and Madhya Pradesh. Bt cotton hybrids are sown at 90-120 cm row to spacing and short duration oilseed crops can be profitably grown in the inter row-spacing that remains vacant during the initial phase of cotton crop. Groundnut and soybean are two oilseed crops that can profitably be intercropped with cotton. Other crops like sesame, safflower, and sunflower have also been experimented with, but are not very popular. Detailed studies on oilseed based intercropping systems have indicated an additional yield advantage of 400-500 kg/ha of groundnut/soybean without significantly decreasing the yield of main cotton crop. Additionally, intercropped groundnut/ soybean benefited the base crop of cotton by either transferring a part of fixed N2 or sparing effect because of their less N requirement. In addition to economic advantage, the intercrops minimise the risk of complete crop failure and provide nutritional fodder for farm animals. This practice also helps in the conservation of soil and better utilisation of rainwater.

The different pulse and oilseed based intercropping systems recommended for different locations are presented in Table 2.

Why Intercropping is Not Favoured by Farmers

Despite several advantages, the adoption rate of cotton based intercropping system in India is not encouraging and there is a discontinuation of this practice in the traditional belt. The following reasons are attributed for low rate of adoption (and discontinuation) of intercropping in cotton.

- Intercropping technology is labour intensive and labour scarcity as well as high wages is a major bottleneck in increased adoption.
- Weeding is labour intensive in cotton. Mechanical weeding using blade harrows, power weeder and tractor drawn implements are becoming popular. These equipments operate well under sole crop situation. Special modifications are needed for intercropped cotton due to narrow row spacing.
- Adoption of chemical-based weed control is recently gaining momentum in cotton. Choice of herbicides is further limited under intercropped situation due to lack of selectivity among certain post emergence herbicides among both base and intercrops.
- Rain aberration like continuous wet spell and dry spell is not uncommon in this era of climate change. Often, the harvesting period of intercrops coincide with rains and the quantity and quality of harvested intercrop are adversely affected.

Table 2: Recommended pulse and oilseed based intercropping systems in cotton

State	Pulse	Oilseed
Punjab	Green gram	
Madhya Pradesh	Black gram	Soybean
Gujarat	Black gram	Groundnut, Sesame
Maharashtra	Green gram, Black gram, Pigeon pea	Soybean, Groundnut
Odisha	Pigeon pea, Black gram	Soybean
Karnataka	Black gram, Cowpea	Soybean, Groundnut
Tamil Nadu	Green gram	Soybean Groundnut
Andhra Pradesh	Blackgram, Pigeon pea	Pigeon pea
Telangana	Pigeon pea, Green gram	Soybean


Cotton+Green gram


Cotton + Black gram


Cotton+Groundnut


Cotton +Soybean

- Non-availability of a complete package of production including choice of varieties of cotton and intercrop also comes in the way ofpopularising intercropping.

- Success of intercropping depends upon complimentarily among crops grown together. If crops or varieties of the crops are not chosen properly, inter-species competition may limit yields and farm profits. There are no specific plant breeding programmes to develop and evaluate varieties under intercropped conditions. Hence the best varietal combinations are seldom available for recommendation in the package of practices.

The Way Forward

- Empowering women cotton farmers with knowledge and skill to enable them act as drivers of this change. Women understand the benefits of integrating pulses, oilseeds and leguminous vegetables in the production systems for enhanced availability of food grains and nutrition for farm families.

- There is a need for fine-tuning the package of practices, including the varieties/hybrid of cotton and intercrop, for different agro-ecological situations. Demonstrations are being conducted under National Food Security Mission by different centresof All India Coordinated Research Projects. These need to be upscaled appropriately.

- Wide spread adoption of intercropping system will only occur with institutional support, enabling policies and incentivised markets. These strongly influence the adoption behaviour of individual farmer.

Intercropping systems in cotton clearly have the potential to increase the production of pulses and oilseed crops. Selection of appropriate crops/varietal combination, planting rates, and changes in the spatial arrangement of the crops can reduce competition and maximise benefits. Even if intercropping with oilseeds is adopted in an additional 2.0millionhectarearea, with an minimum intercrop yield of 0.3 tonnes/ha, the production of oilseeds can be enhanced by another 0.6 million tonnes without any expansion in area.

Similarly, through targeted planning it is possible to introduce short duration pulses as intercrops in around 3.0 million hectares, particularly in assured rainfall areas where cotton is cultivated. Presuming that an average of 0.25 tonnes/ha of pulse yield is realized around 0.75 million tonnes of pulses can be produced without any horizontal expansion in area. Apart from saving our precious foreign exchange, such practices would restore soil health and improve the nutritional status of farm families and the health of farm animals.

(The views expressed in this column are of the author and not that of Cotton Association of India)
