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A Review

Sunnhemp as green manure

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ABSTRACT
Green manuring with sunnhemp is an age-old practice. But with the advent of green revolution, intensive cultivation and use of chemical fertilizer (NPK), rice-wheat-cropping system become the dominant practice both in developed and developing countries. As a result agroecosystem is being affected very badly, which is the burning concern of agriculture scientist all over the world. Sustainable Agriculture is the slogan of these days where sunnhemp can play a pivotal role as green manure in maintaining soil health and agroecosystem. Moreover, with increasing price of fertilizer farmers again realized the importance of sunnhemp. In addition to increasing organic matter, reducing soil Ph and increasing water-holding capacity, the direct and residual response of sunnhemp green manuring is quite encouraging in rice, wheat and sugarcane. Reports on amount of nitrogen addition through green manure varied considerably. But on an average 50-60 kg nitrogen /ha is being added in soil. Moreover due to succulent nature of its foliage it decompose very quickly which makes easy fit in the cropping system. Sunnhemp can be grown as dual purpose also i.e. green manure as well as fibre crop because after harvesting of fibre crop, the top portion (30 cm from top) can be incorporated in to the soil, which substantially increase the yield of succeeding crop.

Key words : Sunnhemp, Green Manure, Agro-ecosystem.

INTRODUCTION

Green manuring and cultivation of quick growing crops for this purpose, chiefly of leguminous family, has been an ancient practice in most parts of the world associated with agriculture. Of the large number of crops used for this purpose, probably none suits the purpose better than *Crotalaria juncea* – a fairly rapid growing plant with relatively short life cycle capable of being raised without any special soil preparation. When ploughed down it requires comparatively short time to decompose and besides acting as an important bio-fertilizer, it also yields fibre (Datt *et al*. 1996). The use of *Crotalaria juncea* as green manure and fibre had led the agriculture scientists to advocate its cultivation in areas deficient in manurial constituents and in such localities where other crops may not be successfully grown (Singh and Singh, 1936; Singh, 1963; Panse *et. al* 1965; Sutaria and Patel, 1975 and Agarwal *et al*., 1993).

With the advent of green revolution in rice and wheat, intensive agriculture and use of highly responsive inorganic fertilizers (NPK) its use as green manure as well as fibre has been drastically reduced. As a result of continuous rice - wheat cropping system with high doses of inorganic fertilizers, agro-ecosystem has been greatly disturbed and productivity of soil, in general, remains stagnant inspite of the addition of more and more fertilizers (Gupta and Tripathi, 2001; Narang and Gill, 1996; Mann and Ashraf, 1985; Dubey *et al*. 1997; Bhardwaj and Datt, 1995). In this backdrop, scientists all over the world started the slogan of "Sustainable agriculture" with Integrated Nutrient Management (INM) where sunnhemp would definitely play an important role in cropping system to restore and maintain the soil health and fertility (Conway and Barbier, 1990).

Time and method of incorporation of green manure :

The time at which a green manure crop should be buried is the most important in deriving the full benefit from the green manure. A number of investigations have been carried out on these aspects of green manuring of sunnhemp in rice, wheat and sugarcane (Panse *et al*, 1965; Mukherjee and Agarwal, 1950; Dubey *et al*, 1997; Singh, 1984). Seven to nine weeks old sunnhemp crop as green manure was found to give significant response in rice and wheat (Sharma *et al*. 2000). In case of sugarcane best result was obtained when sunnhemp was burried at 8-11 weeks after sowing (Singh and Singh, 1936 and Srivastava and Pandit, 1968). Green manuring is done either by growing green manure crop *in situ* and incorporating it in the soil by ploughing before sowing or planting the main crop or by bringing it from elsewhere and incorporating at the appropriate time before the crop is sown. The later one is called green leaf manuring where generally leaves of the perennial crop and trees such as *Gliricidia, Ipomoea carnea* etc are used. However, studies experiment showed that, in cases of sunnhemp or dhaincha, *in situ* green manuring is generally practiced and give better responses in comparison to green leaf manuring.

Crop age and nutrients :

Nutritional studies concomitant with crop age were done by Singh and Singh (1936), Kanwar and Hardyal, (1959) and Srivastava and Pandit (1968). They found that the percentage of organic matter, nitrogen and other essential elements increased with the age of the plant and attained maximum at 60-75 days after sowing.

Nitrogen content of the plant increases gradually upto 60 days of sowing and thereafter it declined. Thus ploughing of the crop before or after 60 days would reduce the maximum manurial efficiency of the crop. Besides nitrogen, other inorganic constituents are also very important. In the dry mater the percentage of ash is gradually increased in the same directions as that of nitrogen. Thus the maximum amount of mineral elements is at two months stage. But

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calcium and potassium which contribute much more than any other elements to the composition of plant body are maximum at 60-75 days after sowing and hence, ploughing of the crop during this period should provide the maximum amount of calcium and potassium (Fig 4-6).

Organic constituents of the green manure plants are equally important for water holding capacity, humus formation, and improvement for physical characters of the soil as well as physico-chemical reactions. Thus assessment of organic components alongwith age is important. The fat and reducing sugar are reducing in the plant parts as the life cycle progresses because of continuous use of these elements for the supply the energy, accordingly if we incorporate at the later stage, it will fail to

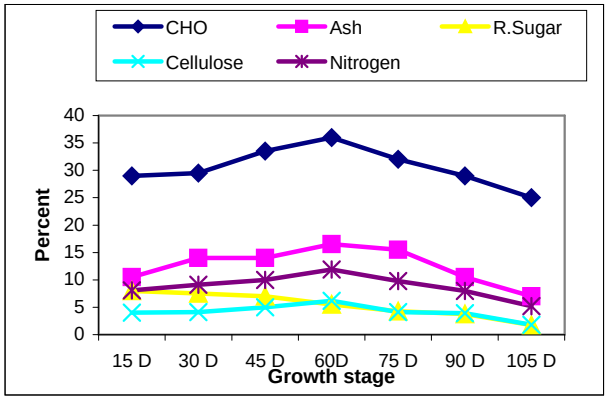

Fig. 1 : Percentage of different plant constituents in leaves

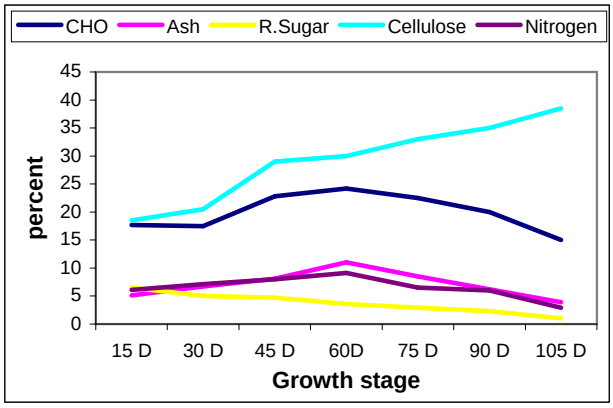

Fig. 2 : Percentage of different plant constituents in stem

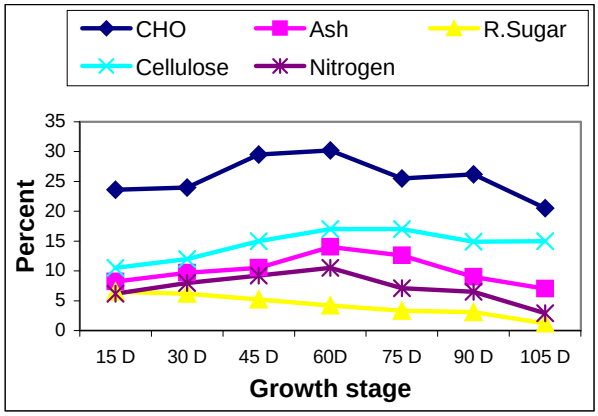

Fig. 3 : Percentage of different plant constituents in root

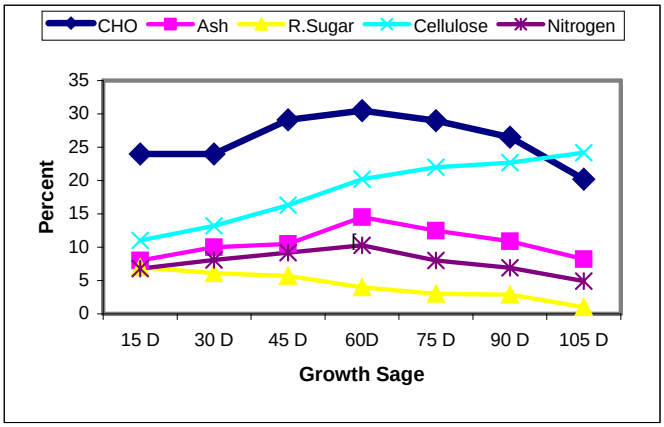

Fig. 4 : Percentage of different plant constituents in whole plant

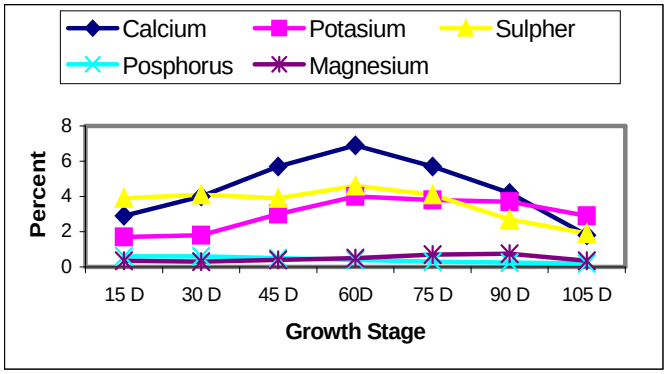

Fig. 5 : Percentage of inorganic constituents in leaves

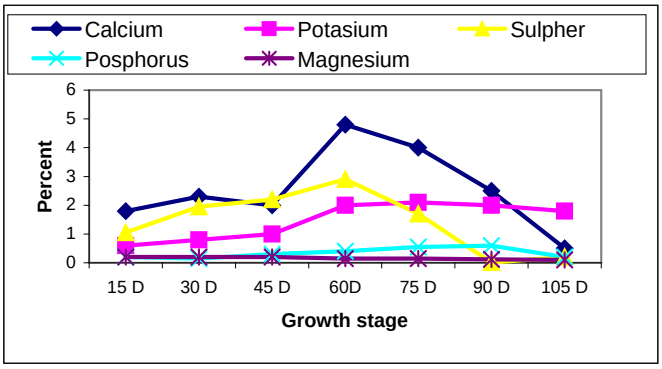

Fig. 6 : Percentage of inorganic constituents in stems

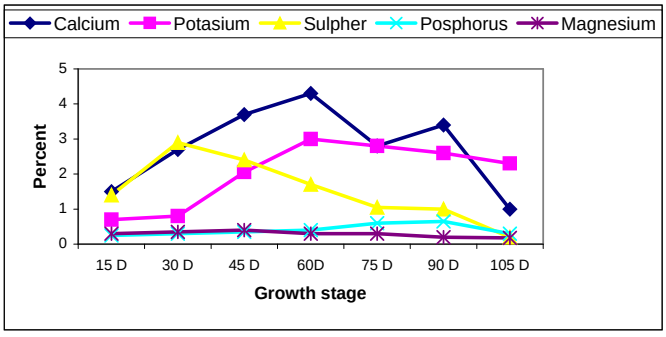

Fig. 7 : Percentage of inorganic constituents in root.

improve the soil health with regard to water holding capacity, physical and chemical properties. Other organic substances such as total carbohydrate and sucrose attain maximum at 60-75 day stage. Cellulose attains their higher values when the plant is at late stage. Thus if we plough the crop at later stage (>60-75 days) low contents of sucrose and total carbohydrate infact reduce the manurial value. Moreover, larger quantity of cellulose after 75 days reduce the manurial value since decomposition of cellulose is delayed in the soil. The absolute quantity of all the elements, however, increases at 90 days stage (Fig 1-4).

If the addition of highest amount of nutrient values is the final goal of green manure without taking into account of the nature of materials, its decomposition and the future availability to succeeding crop, ploughing may be done at 90 DAS. But the quantity of fertilizer constituents is not the only criterion for successful green manuring. Considering all the gamut sides it was reported that green manuring at 60 days after sowing was the best.

Portion to be added :

A number of studies were conducted to assess the efficiency of green manuring of sunnhemp in rice, wheat and sugarcane at different places using different parts of the crop. Sunnhemp green manuring gave a significant response whatever portion of the plant was applied. However, incorporation of whole plant gives the higher response closely followed by incorporation of stubble and next by top portion in sunnhemp-wheat system (Panse *et al.*, 1965; Gupta and Tripathi, 2001). In case of sugarcane, whole plant manuring gives better response than the application of plant parts but the difference in response is not so large if top portion only is incorporated.

Detail investigations on manurial value were determined by Singh and Singh (1936) and Dempsey and Baumann (1970). They found that leaves and tops contain the maximum amount of nutrients and these parts are decomposing in the soil very quickly than any other parts (Table 1). Stem contains least manurial components and highest cellulose, which decomposes very slowly in the soil. The amounts of nutrients added through leaves and top at harvesting (for fibre) is almost 80 percent in comparison to whole plant green manuring (Dempsey, 1972). Thus harvesting at 50 % flowering stage with subsequent incorporation of leaves and top portions are more profitable than the whole plant green manuring because about 3-5-q/ ha^{-1} fibre can be obtained without affecting the succeeding crop (Tandon *et al.*, 1959; Gupta 1968; Singh, 1963; Srivastava and Pandit, 1968).

Quantity of nutrients :

Reports on the amount of organic matter added to the soil by whole plant green manuring varies from 12 – 25 tons/ha^{-1} depending on the time of incorporation. On an average, 15 tons organic matter is added if incorporated at 50-60 days stage. However, variable reports on the addition of nitrogen, phosphorus, potash and calcium are there in the literatures. But on an average 50-75 Kg N ha^{-1}, 15-20 Kg P_2O_5 and 40-65 Kg K O are being added to the soil through green manuring of whole plant (Demsey, 1972; Panse *et al.,* 1965 and Bhattacharya *et al.*, 2003).

Table 1 : Percentage of different nutrients in different parts of sunnhemp

Plant part	N	P	K	Ca
Leaf	4.52	0.35	1.30	2.4
Raw Ribbon	1.7	0.26	1.74	0.37
Wood	0.96	0.1	0.85	0.22

Source: Dempsey, 1975

Response and residual effect :

A large number of trials on response of green manuring were conducted in Tamilnadu, Andhra Pradesh, Mysoor, Punjab, Uttar Pradesh, Orissa, Bihar, and West Bengal, Maharastra using different types of green manuring crop but majority were with sunnhemp. The overall response in rice, wheat and sugarcane is presented in Table 2 (Panse *et. al.,* 1965; Ghuman *et al.,* 1997; Srikantan and Palaniappan, 1993; Alam *et al*., 1997). Similarly residual response of green manuring on rice, wheat and sugarcane was extensively studied in different parts of the country. It appeared that the application of green manuring on rice gives residual response at most of the experiments, the average response being about one third of direct response (Khan and Mathur, 1953). In sugarcane also significant residual response of about one sixth of direct response was recorded. In wheat green manuring *in situ* gave good residual response, almost equal to direct response.

Table 2 : Effect of green manuring with sunnhemp on direct and residual response in rice wheat and sugarcane.

Crop	Direct response	Residual response
Rice	230 kg/ha	1/3rd of direct response
Wheat	98 kg/ha	Equal to direct response
Sugarcane	7.86 tons/ha	1/6th of direct response

Source: Panse *et al*. 1965.

Economics of green manuring :

Study on green manuring in rice conducted by different workers showed that in Andhra Pradesh, Tamilnadu, Maharastra and Uttar Pradesh, it is profitable if seeds are

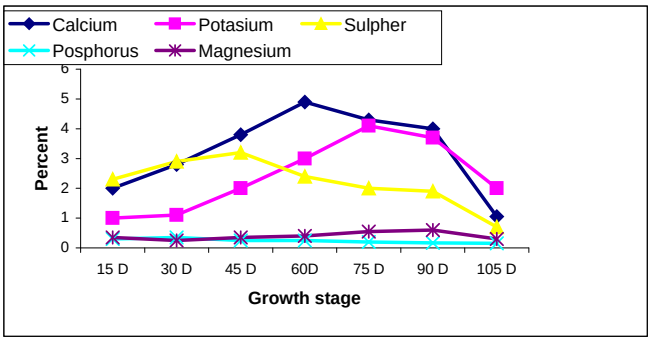

Fig. 8 : Percentage of inorganic constituents in whole plant.

made available with minimum prices. It will attract more farmers to adopt the same because maximum cost in green manuring is incurred for seed purchasing (Panse *et al.*, 1965; Chandani, 1958). In wheat green manuring with sunnhemp is found to be uneconomical because to compensate the cost of green manuring more than 2q/ha^{-1} direct response is to be achieved but 1.6 q/ha^{-1} was reported (Panse *et al.*, 1965). In contrary to this, Gupta and Tripathi (2001) reported that green manuring in wheat significantly increased the wheat yield and resulted more economic benefit. However, growing of sunnhemp as dual purpose (fibre and green manuring) is found to be economical (Gupta *et al.,* 1968). Green manuring with sunnhemp in sugarcane is highly economical because of higher response (7.9 ton/ha^{-1}). In addition to this direct benefit green manuring also improves the soil health as a whole, which has been considerably deteriorated due to increasing dependence on chemical farming in the last 35 years or so.

Limitations :

It is often claimed that the practice of green manuring is widespread and increasing considerably as a result of enhanced extension activities. But survey showed that green manuring was confined to certain areas mostly in South India and Maharastra. In many cases irrigation facilities are not available, where green manuring is not possible. In Andhra Pradesh adequate time to grow green manuring crop after the onset of monsoon is not there. In large parts of Orissa, broadcasting of rice is being practiced before the onset of monsoon; in such cases green manuring is not feasible. In West Bengal, jute is grown before rice, which cannot be replaced by green manuring with sunnhemp. In many wheat-growing areas, one kharif crop such as maize or jowar (fodder) is grown (Punjab and western Uttar Pradesh). In such cases growing of green manuring may not be economical. Even in single crop areas such as eastern Uttar Pradesh green manuring is not found suitable due to low response in wheat. In brief, the following practical limitations may be pointed (Pandya and Patil, 1953).

1. Inadequate facilities
2. Overlapping of season.
3. Non-availability of adequate seeds and high cost of seeds.
4. Time requirement is high. In place of green manuring other crops like pulses gives more return.

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