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A review of foliar nutrition on chlorophyll formation, pod setting index and yield of soybean [*Glycine max* (L.) Merrill]

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Abstract
Soybean is one of the important pulse crop India, it have very nutritious value so it is called wonder crop which is so remunerative that it is being grown by farmers in prescribed agro climatic zones. The productivity of soybean is declining year by year. The main cause for low productivity of soybean is that the crop is cultivated largely under rainfed conditions, with imbalance use of nutrients during crop growth periods. It needs earnest attention in adoption of desirable production technology and use of fertilizer in balance way. The literatures regarding effect of foliar nutrition and related studies.

Keywords: flowering, podding, micronutrients, quality, soybean, yield

Introduction
India has made impressive progress in agriculture during the last three decades, culminating in self-sufficiency in cereals and made good efforts in increasing the production and productivity of pulses and oilseeds crops. Oilseeds crops have been the backbone of country economy from time immemorial. Soybean (*Glycine max* L.) ranks first amongst oil seed crops in the world and is also known as the wonder crop of the twentieth century. It contributes nearly 25 per cent of the world's total oil and fat production.

It is a cheapest source of vegetable oil and protein. It contains about 40 percent protein, well balanced in essential amino acids, 20 percent oil rich with poly unsaturated fatty acids specially Omega 6 and Omega 3 fatty acids, 6-7 percent total mineral and 5-6 percent crude fibre (Chauhan *et al.,* 1988) [4]. The protein quality of soybean is equivalent to that of meat, milk products and eggs. It is generally grown as a rainy season crop under *rainfed* situation predominantly in *Vertisols* and associated soils.

During the last two years shedding of flowers and pods appeared the big problem in soybean cultivation. It is expected that the nutrient imbalance and proper mobilization of food nutrients from different plant parts to reproductive organ however, technology and needed to crop of with this burning problems in formation of seeds. The various study indicated that micronutrient and hormones are simple tools which balance the nutrition in plants and avoided from physiological disorders. Besides many reasons for low productivity of soybean, flower drops plays a significant role for reducing the overall seed yield. However, technology, which can reduce the flower drops, might help in enhancing the seed yield of soybean.

Foliar application of micro nutrients was more beneficial to legumes. However adequate information on the effect of foliar application of Nitrogen, Phosphorus, Potassium, Molybdenum, Boron and Zinc on soybean was not available in Chhattisgarh agro-climatic condition. Considering above state facts, the aim of this review paper is to summarize the foliar nutrition on chlorophyll content, pod setting index and profitability of soybean [*Glycine max* (L.) Merrill] of soybean.

Importance of foliar nutrition in pulse crop
It has been well established that most of the plant nutrients are absorbed through the leaves and absorption would be remarkably rapid and nearly complete. Moreover, foliar feeding practice would be more useful in early maturing crops, which could be combined with regular plant protection programmes. If foliar nutrition is applied it reduces the cost of cultivation which in turn reduces the amount of fertilizer thereby reducing the loss and also economizing crop production. Since foliar nutrition can be adopted wherever possible except for unavailable

circumstances where soil application is only feasible. Foliar application of N at particular stage may solve the slow growth, nodule senescence and low seed yield of pulse without involving root absorption at critical stage (Pandragi *et al*., 1991; Latha and Nadanasababady, 2003) [14, 10].

The interest of foliar fertilizers acrose due to the multiple advantages of foliar application methods such as rapid and efficient response to the plant needs, less product needed and independence of soil conditions. It is also recognized that supplementary foliar fertilization during crop growth can improve the mineral status of plants and increase the crop yield (Elayaraja and Angayarkanni. 2005) [6].

Fertilizer is a vital input in agriculture to boost the crop yields. Among the methods of fertilizer application, foliar nutrition is recognized as an important method of fertilization. Since foliar nutrients usually penetrate the leaf cuticle or stomata and enters the cells facilitating easy and rapid utilization of nutrients. Foliar application of N at particular stage may solve the slow growth, nodule senescence and low seed yield of pulse without involving root absorption at critical stage (Latha and Nadanassababady, 2003) [10]. Manivannan *et al.* (2003) found that *Rhizobium* seed treatment and foliar application of microsol (NPK and Chelated micronutrients) recorded markedly higher leaf area index, dry matter production and crop growth rate. Application of nutrients through foliar spray at appropriate stages of growth becomes important for their utilization and better performance of the crop (Anandhakrishnaveni *et al.,* 2004) [1].

Manivannan *et al.* (2002) [12] revealed that combined application of *Rhizobium* seed treatment and foliar application of N, P, K and chelated micronutrients at 15,30 and 45 DAS resulted in significant growth and yield characters. The foliar application of superphosphate and DAP was found beneficial than soil application in crops (Chandrasekar and Bangunasamy, 2003) [3]. Foliar application of fertilizers as a possible means of applying the needed nutrients for successful crop production is gaining considerable interest in recent years.

Effect of foliar application of nutrients on chlorophyll formation of crops

Chlorophyll contents are one of the important physiological parameter influenced by the applied nutrients which are ultimately affecting the crop yield. Application of RDF + DAP 2 % gave the higher of SPAD value (Chlorophyll content) in the application of pre flowering and pod initiation stage. The lower SPAD value (Chlorophyll content) was observed under the treatment of RDF alone. This may be due to spray of micronutrients promoting the concentration of stimulates such as carbohydrate and nitrogen status in leaves which might be responsive to enhance the chlorophyll contents in leaves and reflected through SPAD value. Kalita (1989) [7]. Foliar nutrition of N also beneficial effect on auxin production which in turn enhance plant growth.

Effect of foliar application of nutrients on pod setting index of crop

The highest number of flower drop under treatments of RDF number of flower drop was although reduced substantially but application of only RDF gave the higher number of flower drop. These would have been the probable cause for the reduction of flower dropped day^{-1}. The highest number of drop was observed under the treatment of RDF whereas, the highest number of pods were observed under the treatment of RDF + DAP 2 % spray at pre flowering and pod initiation stage. The treatment of RDF + DAP 2 % spray at pre flowering and pod initiation also gave the highest pod setting index. The lower pod setting index was observed under the treatment of RDF alone. The similar findings have been also reported by Chandra and Das (2007) [2].

Yield of soybean

Foliar spray of 3 per cent DAP spray at flowering and then a fortnight later significantly increased the number of pods plant^{-1}, 100 grain weight and ultimately grain yield in blackgram and greengram (Rajendran, 1991) [16]. Dwivedi and Tiwari (1991) [5] reported that highest number of cluster and pods was obtained by 2 per cent urea than 2 per cent DAP in chickpea. Shindhe and jadhav. (1995) [17] observed that foliar spray of growth regulators (NAA and ethrel) and KNO_3 in cowpea increased the pod yield plant^{-1}, weight of individual pod and ultimately resulted in elevating the seed yield by 33 per cent.

Pandian *et al*. (2001) [13] reported the application of basal dose of N and P sprayed along with 2 per cent DAP spray registered significantly higher number of pods plant^{-1} and 100 seed weight as compared to control in greengram. More number of pods plant^{-1} was recorded in blackgram when 2 per cent DAP was sprayed along with soil application of potassium foliar application of N, P and K with chelated micronutrients has increased the grain yield of blackgram. Foliar application of one per cent DAP + 0.5 per cent urea recorded significantly more number of pods plant^{-1} in irrigated blackgram (Subramani *et al.,* 2002) [18].

Conclusion

Foliar nutrition is very importance for increasing the yield of crop as well as also the quality parameters of crop. The response of foliar spray of DAP @ 2 percent was also positive and registered significantly higher percentage of pod setting index, SPAD value and also higher in benefits cost ratio.

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