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A review of foliar nutrition in soybean enhancing the growth and yield characters

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Abstract
Soybean is recognized as golden bean because of its high nutritional values and economic importance. Soybean is one of the most important oilseed crops in the world as well as India also*;* 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: Bioefficacy, tetraconazole, cotton, leaf spot, grey mildew

Importance of foliar nutrition in pulse crop

Foliar spraying is one alternative approach through micro nutrients are made to crop in liquid form through foliage (Nasiri *et al*., 2010) [17]. Foliar application of microelements is more beneficial than soil application. Since application rates are lesser as compared to soil application, same application could be obtained easily and crop reacts to nutrient application immediately (Zayed *et al.,* 2011) [18]. Foliar spraying of microelements is very helpful when the roots cannot provide essential micro nutrients to the crop moreover, soil pollution would be a major problem by micronutrients soil application. As people are concerned about the environment, foliar sprays of nutrients are better than soil application. (Bozorgi *et al*., 2011) [2]. It was suggested that micronutrients could be applied successfully to compensate shortage of those elements (Arif *et al*., 2006) [1]. These authors found that based on soil properties, foliar spraying could be more effective 6 to 20 times more as compared to soil application.

Effect of foliar application of nutrients on growth and physiology of crops

A. Plant height

Plant height is one of the important morphological growth parameter influenced by the applied nutrients and growth regulators. Foliar application of micronutrient also helpful to absorb more quantity of macronutrients, such as N, P and K. They have a major role in cell division and development of meristematic tissues, plant height, photosynthesis, respiration and acceleration of crop physiology when the plant doesn't absorb necessary nutrients through root in soybean that there was a pronounced inhibition of shoot growth by salicylic acid seed treatment in green gram. Foliar application of boron and molybdenum brought significant improvement in plant height in chickpea. Pandian *et al.* (2001) [8] reported that application of basal dose of fertilizer along with 2 per cent DAP spray twice registered higher plant height and net return per rupee invested in green gram. Foliar spray of 2 % DAP twice with recommended dose of fertilizer recorded the maximum plant height of chickpea (Srivastava and Srivastava, (1994). Ramesh and Thirumurugan (2001) stated that foliar applications of 2 percent DAP and 1% Kcl along with benzyladenine 25 ppm had significantly increased the plant height in soybean.

B. Leaf area index (LAI)

Leaf area is an important factor determining the dry matter production of a crop and subsequently the yield. Foliar application of DAP @ of 2% might have supplied nitrogen and phosphorus in balance quantity at the flag end of crop might resulted effective translocation of nutrients from one plant part to other lead to increasing the number of leaves plant^{-1} and leaf area in soybean reported by Govindan and Thirumurugan (2000) reported that the growth parameters *viz.,* LAI in green gram were significantly higher with the foliar spray of KNO3

(One per cent) or Kcl (one per cent) and their combination. Subramani and Solaimalai (2000) [15] stated that the poor production potential of black gram attributed to poor photosynthetic efficiency, lack of partitioning of photosynthates to pods and seed setting. They reported the favourable influences of foliar application of nutrients with 1 % DAP + 0.5 per cent urea + 0.25 per cent.

C. Crop growth rate (CGR)

Through the foliar nutrition better absorption of nutrients applied through foliage leading to better activity of functional root, resulting in increasing more leaf area, dry matter production and uptake of nutrients increases the plant dry weight in soybean reported by vinoth *et al.*, (2011). Rajendran (1991) [10] observed that foliar application of 1 % urea significantly increased the number of leaves from 7.9 to 9.0 in greengram. Kalarani (1991) [5] observed that the foliar application of 1 % urea and 50 ppm NAA significantly influenced the specific leaf area in soybean. A similar result was reported by Baghel and Yadhav (1992) [3] with NAA in blackgram. Salim (1992) [11] stated that foliar spraying of 1% urea significantly increased the crop growth rate in soybean. Significantly higher CGR was observed by the application of salicylic acid in rice (Kalpana, 1997) [7].

Effect of foliar application on yield components and yield of soybean

A. Yield

Grain yield is the ultimate economic produce of the crop which is determined by grain weight, number of grains per unit land area as governed by the management practices and its native genetic potential. The significantly maximum yield recorded due to foliar application of N at pod initiation stages of the crop might be due to effectively absorption of micronutrients and translocated to the developing pods, producing more number of pods and more pod filling, resulting in higher seed yield reported by Srinivasan and Ramasamy (1992).The grain yield was increased nearly 32 and 38 per cent in higher level of NP fertilization applied at 60 : 120 kg ha^{-1} coupled with foliar spray of 2 per cent DAP and 0.5 per cent ZnSo4 at flowering stage over normal level of NP fertilization at 20:80 kg ha^{-1} without foliar spray in soybean (Ganesa Raja, 1990) [4]. Solaiappan and Ramiah (1990) studied the effect of foliar spray of three per cent DAP produced slightly higher yield than the combined spray of 1.2 per cent urea+ 8.6 per cent single super phosphate which was significantly higher than the individual application of either urea or single super phosphate (SSP). Foliar spray of 0.5 per cent KNO_3 solution at 50 per cent flowering stage significantly increased the grain yield of high yielding and traditional cultivars by 49.1 and 19.3 per cent, respectively over control in rice. Response of cowpea to foliar nutrition of 2 per cent urea and 2 per cent DAP sprayed on 20 and 30 DAS was studied by Srinivasan and Ramasamy (1992). Spraying 2 per cent DAP produced similar yield to that of soil application of N and P and higher yield than urea spray. Foliar application of DAP at over dose cause reduced the seed yield once or twice because of scorching effect in gram (Setty *et al*., 1992). In summer green gram both 1.5 per cent urea and 0.5 per cent DAP could increase the number of pods, seeds, length of pod and seed yield in greengram (Patel and Patel, 1994) and in soybean Thiyageswari and Ranganathan (1999) [16] reported that foliar application of 0.05 percent Sodium molybadate recorded the highest yield in soybean. Pujari *et al.* (1998) [9] studied the foliar application of urea and triacontanol and reported significant increase in seed yield of pigeon pea. Similarly, Govindan and Thirumuragan (2000) observed that the foliar spray of Kcl (1%) + KNO_3 (1%) increased the grain yield of green gram by 21.8 per cent.

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