Review of foliar nutrition in Redgram enhancing the growth and yield characters

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Abstract: Redgram is one of the important pulse crops, which is so remunerative that it is being grown by farmers in prescribed agro climatic zones. The productivity of red gram is declining year by year. The main cause for low productivity of red gram is that the crop is cultivated largely under energy starved rainfed as well as irrigated conditions, with lack of adequate soil moisture and in low fertile soils. It needs earnest attention in adoption of desirable production technologies. Hence, in early maturing varieties a suitable for production, use of nutrients was of foliar nutrition need to be developed for successful exploitation of redgram crop. The literatures regarding transplanting and foliar nutrition application and related studies were reviewed.

I. Importance of foliar nutrition in pulse

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 Nadasanabady, 2003). Selvam et al. (1999) reported that top dressing of 10 kg Nha⁻¹ to groundnut as foliar spray at two per cent urea pod yielded 2.82 t ha⁻¹ while the same soil application produced 2.47 t ha⁻¹. The impact of foliar application of Kcl 0.5 per cent and NAA 40 ppm was compared and found that crop growth and yield of soybean can be increased by Kcl sprays under water stress conditions by maintaining tissue water potential and preventing water loss (Velu, 1999). It also increased the oil content significantly. Foliage applied macro and micronutrients at critical stages of the crop were effectively absorbed and translocated to the developing pods, producing more number of pods and better filling in soybean (Jayabal et al. 1999). Thiageshwari and Rangnanathan (1999) studied the effect of foliar application of nutrients on the dry matter production and yield of soybean. They also reported that foliar application of NPK with MnSO₄, ZnSO₄, Sodium molybdate and boron yielded the highest seed yield of 1832 kg ha⁻¹ followed by foliar application of boron (1398 kg ha⁻¹) as against the recommended NPK (1225 kg ha⁻¹). Thangaraj (2000) stressed the need for mixing foliar nutrients with growth regulators which will save a lot at a time, energy and money. Moreover the efficiency at some applied nutrients is low due to various losses and fixation in soil. Foliar nutrition is designed to eliminate the problems at fixation and immobilization.

Effect of Potassium nitrate and NAA on growth and yield of red gram was studied by Jayarani Reddy et al, (2004). The foliar application of NAA 20 ppm + KNO₃ 0.5 percent significantly increased the dry matter production, seed yield. A considerable increase in yield (400 kg ha⁻¹) in pigeon pea was observed due to foliar spray of 0.5 per cent Zinc sulphate at flower initiation stage has been reported by Masood Ali and Mishra (2001). Osman et al. (2000) reported that foliar application of Zinc at 0.4 per cent in soybean increased the seed yield. Singh and Singh (2000) reported that foliar application of NAA @ 30 ppm concentration increase number of leaves and branches. Crop management practices can be adopted by applying fertilizers through soil as well as foliage. Under rice fallow situation, there is no possibility of basal application of fertilizer for pulses, since the pulses are sown prior to harvest of rice crop and fertilizer incorporation becomes impossible. Under these circumstances foliar application of nutrients would be more appropriate, efficient and economical than the soil application (Balusamy and Meyyazhagan, 2000).
The interest of foliar fertilizers arose 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). Mishra and Mahatim Singh (2001) opined that foliar application of NAA improved the pod number in pigeonpea. Among the micronutrients Zn, Fe, B, Mn and Mo improved the yield appreciably and foliar spray of micronutrients proved to be economical in pulses (Savithri et al., 2001).

Manivannan et al. (2002) revealed that combined application of Rhizobium seed treatment and foliar application of N, P, K and chelated micronutrients (microsol) at 15, 30 and 45 DAS resulted in significant growth and yield characters. Effect of micronutrient on the productivity of cowpea was studied at S.K. Nagar under the All India Co-ordinated Research Project on Arid legumes showed that 0.5 percent FeSO₄ + 0.5 percent ZnSO₄ spray both at 25 and 45 DAS proved most effective and increased the seed yield by 27.7 percent when compared with control (ICAR, 2002). The foliar application of superphosphate and DAP was found beneficial than soil application in crops (Chandrasekar and Bangunamasamy, 2003). Foliar application of fertilizers as a possible means of applying the needed nutrients for successful crop production is gaining considerable interest in recent years (Malarmathi and Thomas Abraham, 2003). Prakash et al. (2003) reported that combined foliar application of NAA @ 30 ppm on 30and 45 DAS and mepiquat chloride @ 120 ppm on 60 DAS recorded increased yield by 25 percent.

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). 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).

Combined spraying of 0.5 per cent FeSO₄ and 0.5 per cent ZnSO₄ at 45 DAS proved most effective and increased the seed yield by 43.1 percent when compared to control (Anitha et al., 2005). Bhownick et al. (2005) opined that as no tillage operation was done for sowing pulses as a relay crop, it’s difficult to apply fertilizer either through placement or through top dressing. Therefore, the scope of fertilization becomes confined to foliar nutrition in rabi pulses. Foliar application of Bio-gas slurry with panchagavya spray increase grain yield in greengram (Somasundaram et al., 2007). Foliar application of nutrient and growth regulator at pre flowering and flowering stage was seen on reduction in flower drop percentage in green gram (Ganapathy et al. 2008). Foliar application of NAA at 40 ppm at pre flowering stage in Blackgram influenced growth characteristics by showing increased plant height, more number of branches and higher Leaf Area Index (Jayakumar et al. 2008).

II. 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. Elangovan et al. (1995) reported that there was a pronounced inhibition of shoot growth by salicylic acid seed treatment in greengram. Foliar application of boron and molybdenum brought significant improvement in plant height in chickpea (Masood Ali and Mishra, 2001). Pandian et al. (2001) reported that application of basal dose of fertilizer along with 2 percent DAP spray twice registered higher plant height (73.5 cm) and net return per rupee invested in greengram. Foliar spray of 2 percent 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 percent 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. 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) stated that the poor production potential of blackgram 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 percent DAP + 0.5 percent urea + 0.25 percent
magnesium sulphate on grain yield. This treatment also recorded higher LAI along with seed treatment with nutrients. The highest leaf area index was observed by the application of salicylic acid in soybean (Kalpana, 2001). Salicylic acid treatment recorded highest leaf area index (LAI) at flowering stage in sesameum (Uma Devi, 1998) and in french bean by Kanbanala Saranthgem and Nabakumar Singh (2003).

C. Crop growth rate (CGR)
Rajendran (1991) observed that foliar application of 1 per cent urea significantly increased the number of leaves from 7.9 to 9.0 in greengram. Kalarani (1991) observed that the foliar application of 1 per cent urea and 50 ppm NAA significantly influenced the specific leaf area in soybean. A similar result was reported by Baghel and Yadav (1992) with NAA in blackgram. Salim (1992) stated that foliar spraying of 1 percent urea significantly increased the crop growth rate in soybean. Significantly higher CGR was observed by the application of salicylic acid in rice (Kalpana, 1997). Similar result was observed by Kalpana (2001) in soybean.

III. Effect of foliar application on yield components and yield of Redgram

A. Yield components
Kandagal et al. (1990) reported that application of 2 per cent urea at pre bloom stage in mungbean recorded significantly higher number of flowers. Annadurai and Planiappan (1994) reported that foliar spraying of two per cent DAP at boot leaf stage and 50 per cent flowering and post-milk stages increased all the yield attributes in rice. Soybean sprayed with 0, 25, 50, 75, 100, 125 or 150 ppm salicylic acid on 12, 24 or 36 DAS accelerated the floral bud and formation by 2 to 5 days. Number of flowers plant\(^{-1}\) was greater with the foliar application of 50 ppm salicylic acid at 24DAS (Pramod Kumar et al., 1999). 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). Dwivedi and Tiwari (1991) 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) 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. Sharma et al. (1993) reported that salicylic acid enhanced the seed yield of soybean through early floral bud initiation, more flowers and pods plant\(^{-1}\). According to Gomathi (1996) foliar spray of 1 per cent urea increased the number of pods significantly in greengram. In soybean, number of pods plant\(^{-1}\) was greater with the foliar application of 50 ppm salicylic acid at 24 DAS (Pramod Kumar et al., 1999). Pandian et al. (2001) 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 (Yakadri and Ramesh Thakikutu, 2002). According to Manivannan et al. (2002) 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 (Subramanii et al., 2002).

B. 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 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 ZnSO\(_4\) at flowering stage over normal level of NP fertilization at 20:80 kg ha\(^{-1}\) without foliar spray in soybean (Ganesa Raja, 1990). 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). Sarkar and Mukhopadhyay (1990) reported that 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 greengram 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 (Kalarani and Moosa sherriff, 1994). Thyageswari and Ranganathan (1999) reported that foliar application of 0.05 percent Sodium molybdate recorded the highest yield in soybean. Pujari et al. (1998) studied the foliar application of urea and triacontanol and reported significant increase in seed yield of...
pigeonpea. Similarly, Govindan and Thirumurugan (2000) observed that the foliar spray of KCl (one per cent) + KNO3 (one per cent) increased the grain yield of greengram by 21.8 per cent.

IV. Reference


