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Bhavya M
Ph.D. Scholar, Department of Agronomy, Keladi Shivappa Nayaka University of Agricultural and Horticultural Sciences, Shivamogga, Karnataka, India

Yallappa B Doni
Senior Research Fellow, Reward Project, University of Horticultural Sciences, Bagalkot

Vidya NT
Technical Assistant, College of Agriculture, Keladi Shivappa Nayaka University of Agricultural and Horticultural Sciences, Iruvakki, Shivamogga, Karnataka, India

Corresponding Author:
Bhavya M
Ph.D. Scholar, Department of Agronomy, Keladi Shivappa Nayaka University of Agricultural and Horticultural Sciences, Shivamogga, Karnataka, India

Influence of foliar application of 19:19:19 and monopotassium phosphate on economics of green gram (*Vigna radiata* L.)

Bhavya M, Yallappa B Doni and Vidya NT

Abstract
A field experiment was carried out in late *Kharif* 2018 on sandy loam soils at the College of Agriculture, Keladi Shivappa Nayaka University of Agricultural and Horticultural Sciences, Shivamogga, Karnataka, to investigate the impact of foliar application of water-soluble fertilizers on the economics of green gram (*Vigna radiata* L.). The study was designed using a Randomised Complete Block Design with three replications and thirteen treatment combinations and the package of practice (*viz.,* 2% DAP, 1% 19:19:19, 2% 19:19:19, 1% monopotassium phosphate, 2% monopotassium phosphate, 1% 19:19:19 +1% monopotassium phosphate). Applications of all water-soluble fertilizers were made At the 30 and 45 DAS phases of crop development, foliar spray. The results revealed that foliar application of monopotassium phosphate and 19:19:19 each @ 1 percent at 30 and 45 DAS along with the package of practice recorded higher gross returns (Rs. 74393 ha^{-1}) and net returns (Rs. 45175 ha^{-1}). The treatment receiving package of practice and the foliar application of monopotassium phosphate and 19:19:19 each at 1% at 30 DAS showed higher B: C ratio of 2.84 than other treatments.

Keywords: Green gram, water soluble fertilizers, monopotassium phosphate

Introduction

Green gram (*Vigna radiata* L.) is the important legume crop grown in India, among the thirteen pulse crops, which rank third in importance, after chickpea and pigeon pea. In India, it covers area, production and productivity about 4.32 lakh hectares, 21.65 lakh tonnes and 5.46 q ha^{-1}, respectively. Among the different states, Rajasthan, Madhya Pradesh, Uttar Pradesh, Odisha, Maharashtra, Karnataka and Bihar are the most important green gram growing states in India. It is consumed in several forms, including whole grains, dal and sprouts and it is an excellent source of easily digestible, high-quality protein. Greengram comes in second place among pulses in terms of nutritional content. It has a protein content of around 24–25%, which is approximately two-third of the protein content of soybean, twice that of wheat, and three times that of rice. Compared to cereal grains, the protein is relatively high in lysine. As a result, a diet rich in cereal and green gram provides a balanced intake of amino acids.

Similar to other pulses, green gram are regarded as a supplementary crop. It is typically planted on bunds or intercropped with other pulses on marginal soils. A crop of secondary importance in many of these systems, it is mostly cultivated in rainfed situations with inadequate management practices and gets little to no purchased high-cost inputs. Other variables contributing to its low performance include numerous physiological, biochemical, and inherent characteristics. In addition to genetics, physiological factors-such as the slow rate of dry matter accumulation during the pre-flowering phase, the low efficiency with which assimilates to grains are partitioned, the poor pod setting caused by flower abscission, the onset of leaf senescence during the pod development period, and the lack of nutrients during the critical stage of crop growth-as well as several diseases and pests-combined with these factors to form the main causes of the low yield (Mahala *et al.,* 2001) [1]. As a result, green gram productivity in our nation is much below potential and has a lot of scope to grow if better agronomic techniques are used. One of them is the foliar spray of nutrients from both organic and inorganic sources, which is thought to be an effective and economic way to supplement the portion of the crop's nutritional needs at important phases while also maximising the crop's genetic potential.

The usage of mineral fertilisers has been steadily declining over the past several years, particularly when it comes to soil-applied nitrogen, phosphorus and potassium. Instead, non-conventional approaches have been used to augment the mineral nutrition (Haytova, 2013) [5]. These facts set the stage for foliar fertilisation to become even more crucial as a substitute for meeting plant nutrient demands during the growth season. Numerous benefits, including the ability to quickly and effectively use nutrients, prevent losses from leaching, fixation, and regulate plant uptake of nutrients, have led to an increase in interest in foliar fertilization (Manonmani and Srimathi, 2009) [9]. According to Dixit and Elamathi (2007) [2], foliar feeding is frequently the most practical and affordable method of treating plant nutrient deficiencies. Foliar feeding is regarded as one of the most significant fertilization techniques since it allows nutrients to enter cells through the stomata or leaf cuticle and facilitates quick and simple nutrient uptake. It is therefore the quickest method of increasing crop growth (Latha and Nadanassababady, 2003) [6]. When rainfall is insufficient, fertilisers are applied as foliar sprays, which promote effective absorption and utilisation of the nutrients. Though foliar spray is not a substitute for soil application it certainly acts as a supplement to soil application. The extent of flower drop determines the yield and yield attributing characteristics in almost all pulses. Retention of flowers by the plant gives a higher yield than expected yield. Numerous investigations carried out on various crops by scientists worldwide have demonstrated that flower retention can be achieved by foliar application of growth regulators and macronutrients during the stages of flower initiation and pod development, in addition to micronutrients applied to the soil (Chaurasia *et al*., 2005) [6].

Based on the literature, it is anticipated that the spraying of water soluble fertilisers will have significant effects on the growth and yield of green gram. However, there is a lack of information concerning the reaction of green gram to the foliar application of water soluble fertilizers in conjunction with soil application. Hence, present investigation intended to study the effect of foliar application of water soluble fertilizers on the economics of green gram during late *Kharif* 2018.

Material and Methods

A field experiment was carried out in late Kharif 2018 at the College of Agriculture, UAHS, Shivamogga. The experimental site, which is located in Southern Transition Zone of Karnataka, was 650 metres above mean sea level and was located between 13° 58' and 14° 1' North latitude and 75° 34' to 75° 42' East longitude. A Randomised Complete Block Design (RCBD) with three replications and thirteen treatments was used to set up the experiment. *viz*., T_1: Farmers practice (50 kg DAP acre^{-1} as basal application), T_2: Package of practice (RDF of 13:25:25 kg N, P_2O_5 and K_2O ha^{-1} + 7.5 t FYM ha^{-1} + 10 kg $ZnSO_4$ ha^{-1}), T_3: T_2 + DAP spray @ 2% at 30 and 45 DAS, T_4: T_2 + 19:19:19 @ 1% at 30 DAS, T_5: T_2 + 19:19:19 @ 1% at 30 and 45 DAS, T_6: T_2 + 19:19:19 @ 2% at 30 DAS, T_7: T_2 + 19:19:19 @ 2% at 30 and 45 DAS, T_8: T_2 + monopotassium phosphate @ 1% at 30 DAS, T_9: T_2 + monopotassium phosphate @ 1% at 30 and 45 DAS, T_{10}: T_2 + monopotassium phosphate @ 2% at 30 DAS, T_{11}: T_2 + monopotassium phosphate @ 2% at 30 and 45 DAS, T_{12}: T_2 + monopotassium phosphate and 19:19:19 each @ 1% at 30 DAS, T_{13}: T_2 + monopotassium phosphate and 19:19:19 each @ 1% at 30 and 45 DAS. Seeds were dibbled at 5 cm depth with a spacing of 30 cm x 10 cm. Irrespective of treatments, basal dose of fertilizer 13:25:25 N: P2O5: K2O kg ha-1in the form of urea, superphosphate and muriate of potash were supplied to all plots. The required amount of monopotassium phosphate (MPP), DAP and NPK (19:19:19) were applied foliar in two sprays at 30 and 45 DAS. The Randomised Complete Block Design was used to do the analysis of variance (Gomez and Gomez, 1984) [3].

Results and Discussion

The performance of the crop production system is evaluated not only based on crop yield but also based on economic returns and the viability of any technology ultimately rests on economics. Net return and benefit cost ratio is the wage to evaluate the economic viability of any crop production system. When it comes to the cost of cultivation of green gram, the application of T_2 + monopotassium phosphate @ 2 percent at 30 and 45 DAS recorded the highest cultivation cost (Rs. 27698 ha^{-1}), followed by T_2 + monopotassium phosphate and 19:19:19 each @ 1 percent at 30 and 45 DAS (Rs. 27450 ha^{-1}) in comparison to a package of practices (Rs. 25650 ha^{-1}). However, the lowest cost of cultivation (Rs. 25155 ha^{-1}) was incurred for farmers practice (Table 1).

Gross returns are the added income from seed and haulm yield. The yield fluctuations end up being the only thing that can explain this. Data regarding the gross returns of green gram in the current study revealed the fact that in comparison to the package of practices (Rs. 61259 ha^{-1}), application of T_2 + monopotassium phosphate and 19:19:19 each @ 1 percent at 30 and 45 DAS recorded the highest gross returns (Rs. 76470 ha^{-1}). This was followed by T_2 + monopotassium phosphate and 19:19:19 each @ 1 percent at 30 DAS (Rs. 75496 ha^{-1}). Higher seed and haulm yields were the primary cause of this. Farmers' practices generated the lowest gross profits (Rs. 52077 ha^{-1}) (Table 1). Similar findings were also observed by Gupta *et al*. (2011) [4] and Thakare *et al*. (2006) [13].

Because of the greater seed and haulm yields, the T2 + monopotassium phosphate and 19:19:19 each at 1% at 30 and 45 DAS were found to have the maximum net returns of Rs. 49020 ha-1. Due to reduced seed and haulm yields, farmers' practise resulted in a lower net return (Rs. 26922 ha^{-1}). The research of Singhal *et al.* (2019) [12], Nithukumari *et al.* (2018) [11], Mudalgiriyappa *et al.* (2016) [10], and Mallesha *et al.* (2014) [8] provide strong support for these conclusions.T_2 + monopotassium phosphate and 19:19:19, both at 1% at 30 DAS, had the highest benefit-cost ratio (2.84) among the other therapies. This is because the highest gross and net returns are accompanied with the highest cultivation costs.

When compared to T_2 + monopotassium phosphate and 19:19:19 each at 1% at 30 and 45 DAS, which requires an additional monopotassium phosphate spraying and 19:19:19 at 45 DAS that raises its cultivation costs, the gross and net returns were, however, lower (by 2.79 percentage points) than those of T_2 + monopotassium phosphate and 19:19:19 each at 1% at 30 DAS. The lowest BC ratios were reported by farmer practise and a package of practice, with 2.39 and 2.07, respectively.

Table 1: Economics of green gram as influenced by foliar application of water soluble fertilizers

Treatments		Cost of cultivation (Rs. ha^{-1})	Gross returns (Rs. ha^{-1})	Net returns (Rs. ha^{-1})	B:C
T_1	Farmers practice	25155	52077	26922	2.07
T_2	POP	25650	61259	35609	2.39
T_3	T_2 + DAP spray @ 2% at 30 and 45 DAS	26255	65369	39114	2.49
T_4	T_2 + 19:19:19 @ 1% at 30 DAS	26238	66291	40053	2.53
T_5	T_2 + 19:19:19 @ 1% at 30 and 45 DAS	26826	66850	40024	2.49
T_6	T_2 + 19:19:19 @ 2% at 30 DAS	26426	67135	40709	2.54
T_7	T_2 + 19:19:19 @ 2% at 30 and 45 DAS	27202	67726	40524	2.49
T_8	T_2 + MPP @ 1% at 30 DAS	26362	68128	41766	2.58
T_9	T_2 + MPP @ 1% at 30 and 45 DAS	27074	69827	42753	2.58
T_{10}	T_2 + MPP @ 2% at 30 DAS	26674	72037	45363	2.70
T_{11}	T_2 + MPP @ 2% at 30 and 45 DAS	27698	72366	44668	2.61
T_{12}	T_2 + MPP and 19:19:19 each @ 1% at 30 DAS	26550	75496	48946	2.84
T_{13}	T_2 + MPP and 19:19:19 each @ 1% at 30 and 45 DAS	27450	76470	49020	2.79

Note: Farmers practice - 50 kg DAP acre^{-1} as basal application, POP (Package of practice) - 13:25:25 kg N, P_2O_5, K_2O ha^{-1} + 7.5 t FYM ha^{-1} + 10 kg $ZnSO_4$ ha^{-1}, DAP - Di ammonium phosphate, MPP- Mono potassium phosphate, DAS - Days after sowing

Conclusion

The optimum treatment combination from the findings was determined to be the foliar spray of 19:19:19 and monopotassium phosphate at 1 percent each at 30 DAS in conjunction with the package of practice.

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