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Studies on Effect of Foliar Applications on Productivity and Economics of Rainfed Crops on Farmers Field

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Abstract

Most of the part of the Marathwada region is comes under assured rainfall zone. The region receives mean annual rainfall of 880 mm. Rainfall in uncertain and erratic in this region and sometimes suffers from severe droughts. Major crops of the region are soybean, cotton and pigeon pea which grown on large area in Marathwada region of Maharashtra State and are being a preferred crops in *Kharif* season by the marginal and small rainfed farmers. The productivity of these crops particularly in Marathwada region is uncertain due to occurrence of frequent dryspells. Occurrence of 3 to 4 dryspells in July to September is a common feature of the region. The productivity of all crops decreases with either deficiency of rainfall and its distribution or due to moisture stress in critical growth period due to dryspells occurred in July and August. Participatory trials were conducted on farmers' fields during 2019-20 to 2021-22 under the project "National Innovations in Climate Resilient Agriculture" (NICRA) which is in operation at village Babhulgoan in Parbhani District in Marathwada region of Maharashtra. The rainfall data was collected from the nearest rain gauge station. The duration of dryspells and number of dryspells were recorded every year. Farmers were advocated to apply potassium nitrate as foliar spray on major crop The data on crop yield in both the field i.e. with foliar application of potassium nitrate and without its application were recorded. Accordingly, the additional per cent increase in yield was analyzed. This study clearly indicated the advantage of foliar application of KNO_3 during the dryspell for higher yield of soybean, pigeon pea and cotton. The results hold promise for improvement in production potential of dryland crops which can be effectively make crops resilient towards recurring drought events

Key words : Dry spell, Evapo-transpiration, Foliar application, Potassium nitrate

Rainfed agriculture supports to 40 per cent of human population and its contribution is 44 per cent of total food production. The fate of rainfed agriculture oscillates with the quantity and spatial distribution of monsoon. The way of stabilize and enhance productivity in agriculture lies with rain water conservation. Total Agricultural production fails in every season due to occurrence of drought situation in any of the part of the country. The farmer in dry areas will suffer the most from climate change and will require a range of coping strategies to adapt to changing climates.

Marathwada region of Maharashtra state, comprised of eight districts, lies between 170 35' to 200 40' N latitude and 74 0 40' to 780 16' E longitude. The altitude ranges between 300 to 900 m above mean sea level. The climate of Marathwada experiences wide inters districts and intra districts variability. The region experiences wide variability within and in between districts in respect of rainfall situation and also different soil type predominant in various parts of region. Occurrence of frequent droughts, unseasonal rains and hailstorms are the features of climate change in the region.

Soybean is grown on 13 lakh ha area in Marathwada region of Maharashtra state. Majority of the small and marginal farmers prefer to grow soybean during *kharif* season.

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The average productivity of soybean varies depending of monsoon behavior. Occurrence of frequent dryspells affects the productivity of soybean in the region. Marathwada region of Maharashtra state comprises 8 districts with average annual precipitation of 807 mm. The region is dominated by medium black cotton soils (60 %) and followed by heavy and shallow soils 15- 20% each. Assured rainfall zone covers 60-70% area followed by 10-15% by moderate to moderately high rainfall and 15-20% scarcity rain area. Though the majority area falls under assured rainfall zone, it is characterized by 2-3 prolonged dry spells during crop growth.

It is known that the most important factors limiting crop productivity are environmental stresses. This lack of water occurs when the rate of transpiration exceeds water uptake and is a component of several different stresses including drought, salinity and low temperature. Plants have different mechanisms to avoid water deficit. Among them, stomatal conductance is reduced as a part of the systemic response triggered by a signal that originates in the root system. (Mata and Lamattina. 2001). In this context, the study on application of foliar spray of potassium nitrate (KNO_3) to cope with drought situations for attaining sustainable crop yields was undertaken on farmer's field under NICRA programme since 2019-20 to 2021-22.

Materials and Methodology : Participatory trials were conducted on farmers' fields during 2016-17 to 2020-21 under the project "National Innovations in Climate Resilient Agriculture" (NICRA) which is in operation at village Babhulgoan in Parbhani District in Marathwada region of Maharashtra.

Most of the farmers were cultivating soybean under rainfed condition. Farmers were advocated to apply potassium nitrate as foliar spray on soybean crop. Demonstration fields were selected based on the willingness of the farmers to engage in participatory research to evaluate the science based strategy.

The rainfall data was collected from the nearest rain gauge station. The duration of dryspells and number of dryspells were recorded every year. The data on crop yield in both the field i.e. with foliar application of potassium nitrate and without its application were recorded. Accordingly, the gross and net returns were worked out and thus the additional per cent increase in yield was analyzed.

Results and Discussions

Rainfall and dryspells : The data on annual rainfall, crop seasonal rainfall, number of dryspell, dryspell duration and period during 2019-20 to 2021-22 is presented in Table 1.

Table 1. Annual, crop seasonal rainfall, and dry spell details during 2019-20 to 2021-22

Year	Annual rainfall, mm	Crop seasonal rainfall, mm	No. of dry-spell	Dura-tion, Days	Dryspell period
2019	964.2	859.7	4	10	01/07/2019 to 10/07/2019
				13	14/07/2019 to 26/07/2019
				16	15/08/2019 to 30/08/2019
				18	02/10/2019 to 19/10/2019
2020	1098.7	1004.5	4	09	17/06/2020 to 25/06/2020
				12	30/07/2020 to 10/08/2020
				10	28/08/2020 to 06/09/2020
				09	02/10/2020 to 10/10/2020
2021	1610.8	1196.8	4	07	29/06/2021 to 05/07/2021
				22	25/07/2021 to 15/08/2021
				08	23/08/2021to 30/08/2021
				14	18/10/2021 to 31/10/2021

In the last three years, 4 dryspells were observed every year which has resulted moisture stress during crop period.

Effect of Foliar spray on crop yield : The data on mean grain yield, % increase in yield, net returns, RWUE and BC ration as effect of application of foliar spray (KNO_3) on soybean crop is presented in Table 2.

Data indicated that soybean grain yield was found significantly increase by 18.99 per cent due to foliar application during dryspell. The mean soybean grain yield with application of foliar spray was recorded as 1159 kg ha^{-1} as against the grain yield of 974 without foliar spray. The net returns of Rs. 23375 ha^{-1} was observed due to foliar application with BC ratio of 1.97 as against the BC ratio of 1.60 without foliar application. The rain water use efficiency (RWUE) was recorded as 1.97 with foliar application.

Adkine *et al.*, (2011), Gowthami and Rama Rao (2014) and Shruthi (2013) studied the effect of boron, molybdenum and potassium nitrate on growth, yield and economic of soybean. They found that application of potassium nitrate resulted in increase in soybean yield. Similar results were obtained in the present study related to yield enhancement of soybean due to application of potassium nitrate during dryspell.

The data on mean grain yield, % increase in yield, net returns, RWUE and BC ration as effect of application of foliar spray (KNO_3) on pigeon pea crop is presented in Table 3.

Data indicated that cotton yield was found significantly increase by 23.90 per cent due to

Table 2. Effect of foliar spray of KNO_3 on soybean productivity and economics

Intervention	Soybean grain yield (kg ha^{-1})				% increase in yield	RWUE (kg ha^{-1} -mm)	Net returns (Rs. ha^{-1})	B:C ratio
	2018-19	2019-20	2020-21	Mean				
With foliar spray of KNO_3	1170	992	1315	1159	18.99	1.76	23375	1.97
Without foliar spray of KNO_3	870	772	992	974		1.34	16477	1.60

Table 3. Effect of foliar spray of KNO_3 on pigeon pea productivity and economics

Intervention	Pigeon pea grain yield (kg ha^{-1})				% increase in yield	RWUE (kg ha^{-1} -mm)	Net returns (Rs. ha^{-1})	B:C ratio
	2018-19	2019-20	2020-21	Mean				
With foliar spray of KNO_3	1272	1344	1235	1284	21.47	1.83	43140	2.24
Without foliar spray of KNO_3	1096	1098	978	1057		1.39	30100	1.94

Table 4. Effect of foliar spray of KNO_3 on cotton productivity and economics

Intervention	Cotton yield (kg ha^{-1})				% increase in yield	RWUE (kg ha^{-1} -mm)	Net returns (Rs. ha^{-1})	B:C ratio
	2018-19	2019-20	2020-21	Mean				
With foliar spray of KNO_3	1411	1350	1298	1353	23.90	1.89	42608	2.29
Without foliar spray of KNO_3	1145	1120	1011	1092		1.62	36609	1.92

foliar application during dryspell. The mean cotton yield with application of foliar spray was recorded as 1353 kg ha^{-1} as against the grain yield of 1092 without foliar spray. The net returns of Rs. 42608 ha^{-1} was observed due to foliar application with BC ratio of 2.29 as against the BC ratio of 1.92 without foliar application. The rain water use efficiency (RWUE) was recorded as 1.89 with foliar application.

Earlier researchers like Jabeen, *et al.*, (2011) studied the effect of foliar application of potassium nitrate affects the growth and nitrate reductase activity in sunflower and safflower leaves and salinity. Shinde et al., (1994) studied the effect of potassium nitrate and urea on growth and yield of cowpea (Vigna unguiculata. Patel and Pater (2008) observed changes in flower abscission, fruit drop and yield in mungbean bean as influenced by foliar spray of PGRs, urea and KNO_3. The results of the present study confirms with the results of previous work.

Conclusion

This study clearly indicated the advantage of foliar application of KNO_3 during the dryspell for higher yield of soybean, pigeon pea and cotton. The results hold promise for improvement in production potential of dryland crops which can be effectively make crops resilient towards recurring drought events. Hence foliar spray of KNO_3 can be recommended for dryland region of Marathwada to ensure higher returns for farmers.

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