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Research Paper

Relevance of water-soluble foliar-grade fertilizers on groundnut (*Arachis hopogaea*) under Konkan condition

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ABSTRACT

A field investigation was conducted on the lateritic soils of Konkan at Agricultural Research Station, Shirgaon, Ratnagiri, Maharashtra during the winter (*rabi*) seasons of 2011–14, to elicit response of groundnut (*Arachis hypocaea* L.) cultivar 'TKG Bold' to water-soluble foliar-grade fertilizers. Twelve treatments replicated thrice laid out in randomized block design. The application of FYM @ 7.5 t/ha + 100% recommended dose of NPK (RDNPK) (25 : 50 : 00 NPK kg/ha) along with starter dose of 2% foliar-grade water-soluble fertilizer (starter dose of 11 : 36 : 24 at 30 days after sowing (DAS) and booster dose of 8:16:39 NPK kg/ha at 45 DAS recorded significantly higher pod and kernel yields (2.9 and 2.24 t/ha, respectively) and was at par with FYM @ 7.5 t/ha + 85% RDNPK + foliar application of water-soluble grade fertilizer (FAWSGF) and 100% RDNPK + FAWSGF. However, FYM @ 7.5 t/ha + 100% RDNPK along with FAWSGF resulted in significantly higher haulm yield (3.25 t/ha) but at par with FYM @ 7.5 t/ha + 100% RDNPK. The increment in pod, kernel and haulm yields owing to FYM @ 7.5 t/ha + 100% RDNPK (25 : 50 : 00 NPK kg/ha) along with 2% FAWSGF was to the tune of 52.6, 55.3 and 53.2% respectively, over the absolute control. The highest net returns (₹33,022/ha) and benefit: cost ratio (1 : 1.41) was obtained with application of FYM @ 7.5 t/ha + 100% RDNPK along with FAWSGF.

Key words : Economics, Foliar application of water-soluble grade fertilizer, Groundnut, Pod yield, RDNPK

Among the nutrients, nitrogen, phosphorus, potassium, calcium and sulphur plays an important role in the nutrition of groundnut crop. Proper plant nutrition is very important for good plant health and productivity of crop. Inadequate nutrient content in soil may interrupt availability of nutrients in soil; however, foliar application of nutrients may compensate or alleviates this inadequacy. Furthermore, it has been observed that fertilizer efficiency particularly urea application through soil is not as effective as if it is applied as foliage application, because only 20 to 50% of the soil-applied nitrogen is recovered by annual crops. Foliar applications can supplement soil nutrients and provide a small boost in growth and yield. Foliar feeding is an excellent, short-term and often most effective economic way to correct nutritional deficiencies in plants, especially those caused by micronutrients. Foliar application of nutrients may increase crop yield and improve in quality (Roemheld and El-Fouly, 1999). El-Fouly and El-Sayed (1997) revealed that foliar application of nutrients may actually promote root absorption of the same nutrient or other nutrients through improving root growth and increasing nutrient uptake. This concept of foliar application implies that nutrient applied to leaves and other aboveground plant parts are absorbed and taken up by the plants.

Besides this, groundnut is an unpredictable legume, since its response to nutrient application is always not optimistic. Excessive application of nutrients may often result in excessive vegetative growth. Soils of Konkan region of Maharashtra are acidic in nature that leads high degree of fixation or nutrient losses from leaching. Hence application of relevant foliar-grade fertilizers directly to the aerial portion of plants is advantageous, owing to low rate of application, uniform distribution of fertilizer material and quick response to applied nutrients (Umar *et al.,* 1999). Foliar fertilization generally has greater economic value in agronomic crops and become an established procedure to improve nutrient utilization and lower environmental pollution through reducing the amount of fertilizer added to soil (Abou-El-Nour, 2002).

Future for foliar feeding does not lie entirely, although it does in part, in achieving growth and yield responses

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above those that could be procured from the most effective soil fertilization programme. In the convenience of applying nutrients in an all-purpose foliar spray is a most attractive consideration. Therefore, it is essential to study the impact of water-soluble foliar-grade fertilizers on the growth and yield of groundnut under lateritic soils of konkan.

MATERIALS AND METHODS

The field experiment was conducted at Agricultural Research Station, Shirgaon, Ratnagiri, Maharashtra during the winter (*rabi*) seasons of 2011–12 to 2013–14. Experimental site was high in organic matter (1.51 %), moderately acidic in reaction (pH 6.2) and electrical conductivity of 0.050 dS/m, medium in available nitrogen (296.1 kg/ha) and high in available phosphorus (18.30 kg/ha) and available potassium (366.20 kg/ha). The experiment was laid out in randomized block design with 12 treatments and replicated, thrice, viz. absolute control (without FYM, RDNPK and foliar application of water-soluble grade fertilizers), 100% RDNPK (25 kg N, 50 kg P_2O_5, 00 kg K_2O through urea and single superphosphate), foliar application of water-soluble grade fertilizers @ 2% (FAWSGF) which was given as starter dose (11 : 36 : 24) at 30 days after sowing (DAS) and booster dose (8 : 16 : 39) at 45 DAS, 100% RDNPK + FAWSGF, FYM @ 7.5 t/ha + 100% RDNPK, FYM @ 7.5 t/ha + 100% RDNPK + FAWSGF, FYM @ 7.5 t/ha + 85% RDNPK, FYM @ 7.5 t/ha + 85% RDNPK + FAWSGF, FYM @ 7.5 t/ha + 60% RDNPK, FYM @ 7.5 t/ha + 60% RDNPK + FAWSGF, FYM @ 7.5 t/ha + 35% RDNPK and FYM @ 7.5 t/ha + 35% RDNPK + FAWSGF. All the recommended packages of practices were adopted. Groundnut variety 'Trombay Konkan Groundnut Bold' 'TG 19A' was sown at 30 cm × 15 cm spacing using a seed rate of 125 kg/ha on gross plot size of 5.10 m × 3.00 m. Agronomic yield was determined plot basis and converted into per hectare yield. The economics was calculated based on prevailing market prices of inputs.

RESULTS AND DISCUSSION

Growth and yield attributes

Plant height and number of branches/plant did not reach the level of significance due to application of water-soluble foliar-grade fertilizers (Table 1). However, total number of pods/plant and dry pod weight of groundnut were significantly influenced by application of water soluble foliar-grade fertilizers and recorded higher under FYM @ 7.5 t/ha + 100% RDNPK (25 : 50 : 00 NPK kg/ha) + 2% FAWSGF (starter dose of 11 : 36 : 24 at 30 DAS and booster dose of 8 : 16 : 39 NPK kg/ha at 45 DAS). In respect of number of pods/plant, application of FYM @ 7.5 t/ha + 85% RDNPK + FAWSGF, FYM @ 7.5 t/ha + 60% RDNPK + FAWSGF, FYM @ 7.5 t/ha + 100% RDNPK and FYM @ 7.5 t/ha + 85% RDNPK were at par with application of FYM @ 7.5 t/ha + 100% RDNPK (25 : 50 : 00 NPK kg/ha) + 2% FAWSGF. Moreover, application of FYM @ 7.5 t/ha + 85% RDNPK + FAWSGF and 100% RDNPK + FAWSGF were at par with FYM @ 7.5 t/ha + 100% RDNPK (25 : 50 : 00 NPK kg/ha) + 2%

Table 1. Effect of water-soluble foliar grade fertilizer on growth and yield attributes of groundnut (pooled data of 3 years)

Treatment	Plant height (cm)	Branches/ plant	Total number of pods/ plant	Dry pod weight (g/plant)	Shelling (%)	Sound mature kernels (%)	100-kernel weight (g)
Absolute control	36.7	3.1	10.1	14.4	72.1	83.1	54.6
100% RDNPK (25 kg N, 50 kg P_2O_5, 00 kg K_2O)	39.0	3.4	12.8	18.9	74.7	83.9	58.2
FAWSGF @ 2% + starter dose at 30 DAS and booster dose at 45 DAS	40.2	3.4	13.1	18.5	77.0	84.0	57.1
100% RDNPK + FAWSGF	43.2	3.3	14.6	20.3	76.8	85.9	60.2
FYM @ 7.5 t/ha + 100% RDNPK	39.4	3.4	15.9	24.6	75.4	85.6	61.9
FYM @ 7.5 t/ha + 100% RDNPK + FAWSGF	40.1	3.5	18.1	26.9	76.4	87.8	66.4
FYM @ 7.5 t/ha + 85% RDNPK	39.4	3.4	15.7	23.0	75.1	85.4	60.9
FYM @ 7.5 t/ha + 85% RDNPK + FAWSGF	41.1	3.5	17.1	24.8	74.8	87.6	61.8
FYM @ 7.5 t/ha + 60% RDNPK	39.3	3.2	13.5	19.9	74.5	86.1	62.7
FYM @ 7.5/t ha + 60% RDNPK + FAWSGF	39.0	3.2	16.0	23.0	76.0	86.8	60.8
FYM @ 7.5 t/ha + 35% RDNPK	38.7	3.2	13.1	19.8	75.3	86.4	60.3
FYM @ 7.5 t/ha + 35% RDNPK + FAWSGF	40.7	3.4	14.1	19.9	78.3	86.3	61.2
SEm±	2.8	0.22	0.92	0.89	0.80	0.89	0.83
CD (P=0.05)	NS	NS	2.59	2.52	2.26	2.51	2.35

RDNPK, Recommended dose of NPK; FAWSGF, foliar application of water-soluble grade fertilizer; DAS, days after sowing

FAWSGF for dry pod weight of groundnut. Oosterhuis (1998) reported that foliar feeding of nutrients may actually promote root absorption of nutrients and improve in root and growth of plant. Veerabhadrappa and Yeledhalli (2005) also reported increase in number of pods/plant, dry pod weight and dry matter of groundnut with 1% foliar spray at 60 DAS in groundnut.

Yield

Application FYM @ 7.5 t/ha + 100% RDNPK (25 : 50 : 00 NPK kg/ha) along with 2% FAWSGF (starter dose of 11 : 36 : 24 at 30 DAS and booster dose of 8 : 16 : 39 NPK kg/ha at 45 DAS) recorded significantly higher pod, kernel and haulm yield. Application of FYM @ 7.5 t/ha + 85% RDNPK along with FAWSGF and FYM @ 7.5 t/ha + 100% RDNPK were at par with FYM @ 7.5 t/ha + 100% RDNPK (25 : 50 : 00 NPK kg/ha) treatment, respectively for pod and kernel yield (Table 2). Also, FYM @ 7.5 t/ha + 100% RDNPK along with FAWSGF resulted in significantly higher haulm yield over all the treatments except the FYM @ 7.5 t/ha + 100% RDNPK treatment which was at par with FYM @ 7.5 t-ha + 100% RDNPK along with FAWSGF. The lowest pod, kernel and haulm yields were recorded in the absolute control treatment, i.e. without FYM, RDNPK and foliar application of water-soluble grade fertilizers. Patel *et al.* (2008) also revealed significant response of groundnut to foliar spray of seaweed liquid fertilizers (SLF) @ 3.5% at 15, 30 and 45 days after sowing on Zn-and Fe-deficit soil.

The increment in pod and kernel yield owing to application of FYM @ 7.5 t/ha + 100% RDNPK over the absolute control was to the tune of 53.63 and 55.32%. The maximum harvest index of 0.42 was noticed under treatment FYM @ 7.5 t/ha + 85% RDNPK + FAWSGF and 100% RDNPK + FAWSGF. The successive increment in growth characters and yield by foliar fertilization may be owing to sprayed solution of nutrients which is readily absorbed by the leaves and not lost through fixation, decomposition and leaching which was in harmony with those reported by Ibrahim and Mona Eleiwa (2008). Foliar application of major and micronutrient had remarkable influence on crop yield which might be due to their critical role in growth, involvement in photosynthesis, respiration and other biological and physiological activates and

Table 2. Yield and economics of groundnut as influenced by foliar application of water soluble grade fertilizer (pooled data of 3 years)

Treatment	Dry pod yield (t/ha)	Kernel yield (t/ha)	Haulm yield (t/ha)	Harvest Index	Gross returns (×10³ ₹/ha)	Cost of cultivation (×10³ ₹/ha)	Net returns (×10³ ₹/ha)	Benefit : cost ratio
Absolute control	1.39	1.00	1.52	0.40	54.1	58.7	- 4.6	0.9
100% RDNPK (25 kg N, 50 kg P_2O_5, kg K_2O)	2.03	1.53	2.24	0.40	77.6	61.8	15.8	1.24
FAWSGF @ 2% + starter dose at 30 DAS and booster dose at 45 DAS	1.74	1.37	2.06	0.40	67.3	60.6	6.7	1.1
100% RDNPK + FAWSGF	2.13	1.69	2.33	0.42	80.8	64.9	15.9	1.24
FYM @ 7.5 t/ha + 100% RDNPK	2.60	1.97	3.07	0.39	99.1	74.1	25.0	1.33
FYM @ 7.5 t/ha + 100% RDNPK + FAWSGF	2.93	2.24	3.25	0.41	111.9	78.9	33.0	1.41
FYM @ 7.5 t/ha + 85% RDNPK	2.43	1.83	2.55	0.42	92.8	72.6	20.3	1.27
FYM @ 7.5 t/ha + 85% RDNPK + FAWSGF	2.67	1.99	2.83	0.41	101.7	76.6	25.0	1.32
FYM @ 7.5 t/ha + 60% RDNPK	2.31	1.72	2.51	0.41	88.6	71.0	17.6	1.23
FYM @ 7.5/t ha + 60% RDNPK + FAWSGF	2.44	1.85	2.73	0.41	93.1	74.5	18.6	1.24
FYM @ 7.5 t/ha + 35% RDNPK	2.15	1.62	2.42	0.40	82.9	69.5	13.3	1.18
FYM @ 7.5 t/ha + 35% RDNPK + FAWSGF	2.23	1.75	2.37	0.42	85.0	72.6	12.3	1.16
SEm±	0.14	0.11	0.14	–	–	–	–	–
CD (P=0.05)	0.40	0.31	0.40	–	–	–	–	–

Produce and input rates

Rabi season	Pod yield (₹/kg)	Haulm (₹/kg)	N (₹/kg)	P_2O_5 (₹/kg)	FAWSF (₹/kg)	FYM (₹/tonne)	Labour charges (₹/day)	Seed (₹/kg)
2011-12	30	1.00	12.04	20.63	150	1000	120	50
2012-13	35	1.50	12.26	37.50	150	1000	120	60
2013-14	45	1.50	12.26	37.50	150	1000	162	63

FAWSGF – Foliar application of water soluble grade fertilizers; FYM – Farm yard manure; RDNPK - Recommended dose of nitrogen, phosphorus and potassium.

thus in higher yield of crop as reported Saliah (2013).

There was significant influence of application of water-soluble fertilizers on shelling (%), sound mature kernels and 100-kernel weight. The application of FYM @ 7.5 t/ha + 35% RDNPK + FAWSGF showed higher shelling % over rest of the treatments and significant over the absolute control, but remained at par with application of FAWSGF @ 2% + starter dose at 30 DAS and booster dose at 45 DAS, 100% RDNPK + FAWSGF and FYM @ 7.5 t/ha + 100% RDNPK + FAWSGF treatments in descending order of significance. There were very meagre differences in sound mature kernels due to application of water-soluble foliar-grade fertilizers. Application of FYM @ 7.5 t/ha + 100% RDNPK along with FAWSGF produced higher significantly higher sound mature kernels over the absolute control. Similarly, application of FYM @ 7.5 t/ha + 100% RDNPK along with FAWSGF resulted in significantly highest 100-kernel weight over rest of the treatments. Similar results were reported by Choudhary *et al.* (2014).

Economics

The application of FYM @ 7.5 t/ha + 100% RDNPK along with FAWSGF provided the highest net returns and benefit: cost ratio which was followed by the application of FYM @7.5 t/ha + 100% RDNPK (Table 2). The absolute control recorded the lowest gross monetary returns net monetary returns and benefit: cost ratio (0.90).

Groundnut cultivar 'TKG Bold' supplied with FYM @ 7.5 t/ha + 100% RDNPK (25:50:00 NPK kg/ha) along with 2% foliar grade water soluble fertilizer (starter dose of 11:36:24 at 30 DAS and booster dose of 8:16:39 NPK kg/ha at 45 DAS) recorded significantly higher pod and kernel yield (2.9 and 2.24 t/ha, respectively) with highest net returns of ₹33,022/ha and B: C ratio of 1:1.41 on the latertic soils of Konkan.

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