Effect of foliar application of water-soluble fertilizer and humic acid on physico-chemical properties and fertility status of soil after rose cultivation

Abstract

The present study highlights the effect of foliar application of water-soluble fertilizer and humic acid on yield and quality of rose (*Rosa* spp). The study was carried out during *Rabi* season at PG Research unit, Horticulture Section, College of Agriculture, Nagpur during 2022-2023.The experiment was laid out in Factorial Randomized Block Design. The treatments comprised of four levels of WSF (19:19:19) *viz.,* Control, 200 g, 300 g and 400 g and three levels of humic acid *viz.,* Control, 500 ppm and 750 ppm giving twelve treatment combinations replicated thrice. In respect of available NPK after harvesting was found superior in treatment combination (F_4H_3) i.e. application of 400 g 19:19:19 with 750 ppm humic acid.

Keywords: Rose, water soluble fertilizer, humic acid, soil fertility

Introduction

Rose is native of USA and belongs to the family Rosaceae. It is a woody perennial flowering plant of genus *Rosa.* There are over three hundred species and tens thousands of cultivars of rose They form a group of plants that can be erect shrubs, climbing or trailing with stems that are often armed with sharp prickles. Rose flowers vary in size and shape and are usually large and showy, in colour's ranging from white through yellows and reds. Rose is commercially grown mainly for its cut flower production and grown mainly for Rose hips are high in vitamin C, are edible raw and occasionally made into jam, jelly, marmalade, rose syrup and soup, or are brewed for tea (Angier and Bradford, 1974). The antiseptic nature of rose petals make them a wonderful treatment for wounds, bruises, rashes and incisions, their anti-inflammatory properties make them a wonderful treatment for sore throats or ulcers. The extract of the rose petals is used as drops or eye wash in burning sensation of the eyes (Chahar, 2016). So, for its cultivation balanced fertilisation are required. water-

soluble fertilizers are easily absorbed by plants and demonstrate higher nutrient use efficiency compared to conventional fertilizers. Foliar application provides ample scope for utilization of nutrients more efficiently and for correcting the deficiencies rapidly. It also helps in the reduction in loss of nutrients. The great difficulty in supplying the macro nutrients through foliage is the non-availability of suitable water-soluble fertilizers, which are a better source of nutrients for foliar application (Vibhute, 1998). Humic acid is a natural polymeric composition which is produced as a result of decaying organic matter in soil, peat and lignin and can be used in order to increase crop production (Sabzevari *et al.* 2008).

Materials and Methods

The experiment was conducted at PG Research Farm, Horticulture Section, College of Agriculture, Nagpur during the year 2022-23. The experiment was superimposed on ongoing experiment at Section of Horticulture, College of Agriculture, Nagpur. (21.15^{o}N and 79.09^{0}E, 310.50 m above MSL). Nagpur is characterized with hot and dry summer from March to May, warm and humid monsoon from June to October and fairly cold winter from November to February. The area shows wide fluctuation of temperature. The soil of experimental site was medium black in colour with good drainage. The soil properties before start of experiment is neutral in reaction (pH 7.22), medium in salt concentration (0.24 dSm^{-1}), moderately low in organic carbon (4.70 g kg^{-1}), low in calcium carbonate (2.76%), low in available N (230.2 kg ha^{-1}) and available P (13.07 kg ha^{-1}), moderately high in available K (248.3 kg ha^{-1}) and low in available sulphur (11.68 kg ha^{-1}).

The experiment was laid out to study the effect of water soluble fertilizer and humic acid on fertility status of soil after harvest of rose. The research was carried out on variety First red.

Twelve treatment combinations with four levels of 19:19:19 viz. 0, 200, 300 and 400 g and three levels of humic acid 0, 500 and 750 ppm were tested in factorial randomized block design with three replications. The different combinations of water soluble fertilizer and humic acid as: T_1 - 0 g 19:19:19 + 0 ppm HA (F_1H_1), T_2 - 0 g 19:19:19 + 500 ppm HA (F_1H_2), T_3 - 0 g 19:19:19

+750 ppm HA (F_1H_3), T_4 - 200 g 19:19:19 + 0 ppm HA (F_2H_1), T_5 - 200 g 19:19:19 + 500 ppm HA (F_2H_2), T_6 - 200 g 19:19:19 + 750 ppm HA (F_2H_3), T_7 - 300 g 19:19:19 + 0 ppm HA (F_3H_1), T_8 - 300 g 19:19:19 + 500 ppm HA (F_3H_2), T_9 - 300 g 19:19:19 + 750 ppm HA (F_3H_3), T_{10} - 400 g 19:19:19 + 0 ppm HA (F_4H_1), T_{11} - 400 g 19:19:19 + 500 ppm HA (F_4H_2), T_{12} - 400 g 19:19:19 + 750 ppm HA (F_4H_3).

The raised beds of 25 m length and 0.9 m breadth and 40 cm height were prepared. Distance between the two beds was 50 cm. Three to four months old budded rose plants were planted in above raised beds during the year 2018-19. The common recommended dose of 300:200:200 ppm NPK plant^{-1} was applied at three split doses 1st split was given in the month of October, 2nd split was given in December and 3rd split was given in the month of January to all the plots (Singh and Peter, 2014). Package of practices including irrigation were adopted as per recommendation.

Sterilized growing media (soil + sand + rice husk + FYM + cocopeat) treated with *Trichoderma viridae* was used for planting rose plants. Spraying of water soluble fertilizer and humic acid will be done after pruning of rose plants. As regards the treatment of water-soluble fertilizer 19:19:19 was calculated accordingly 200 g, 300 g, 400 g of WSF has applied @ 5 g L^{-1}, 7.5 g L^{-1} and 10 g L^{-1} in 40 splits in two days interval through foliar application. As regards humic acid application dose of humic acid was also calculated as per treatments and applied as foliar application in two equal splits at 15 days and 30 days after pruning.

Observations on various growth, flowering and yield parameters five plants will be recorded randomly in each treatment plot. A composite soil sample from the experimental site was collected before the crop was transplanted to know the nutrient status of the soil before the application of fertilizer.

After the harvesting of crop, the surface soil samples were collected (15-20 cm depth) from each treatment plot using screw auger. Soil samples collected were mixed and spread on small cotton cloth bags for air drying. Then the samples were ground and sieved through 2 mm sieve. The chemical properties *viz.,* pH was determined in 1:2.5 soil water suspension with the help

of glass electrode using pH meter (Jackson, 1973), Electrical conductivity (EC) of the soil was determined in 1:2.5 soil water suspension using conductivity bridge (Jackson, 1973), Organic carbon was estimated by Walkley and Black's (1934) Wet Oxidation method and Calcium carbonate was estimated by Rapid Titration method (Piper, 1966). Nitrogen content was determined as alkaline per magnate method described by Subbiah and Asija (1956), While phosphorus was estimated by using Olsen's method reagent (Olsen and Sommer 1982), potassium was extracted by 1N ammonium acetate of pH 7.0 and determined by using flame photometer as described by Jackson (1973) and sulphur determined by turbidity method given by Chesnin and Yien (1951). Data were statistically analysed in FRBD (Gomez and Gomez, 1984)

Results and Discussion

Effect of water soluble fertilizer and humic acid on physico-chemical properties of soil

In the present investigations, a residual effect of various nutritional treatments on the physico-chemical properties was studied. Effect of water soluble fertilizer and humic acid individually and combine application have no significant effect on pH, EC, organic carbon and calcium carbonate of soil (Table 1 and 2).

Table 1: Effect of water soluble fertilizer (19:19:19) and humic acid on physico-chemical properties of soil

Treatments	pH	EC (dSm^{-1})	Organic carbon ($g\ kg^{-1}$)	Calcium Carbonate (%)
Fertilizer (F)				
F_1 Control	7.24	0.25	4.87	2.78
F_2 @ 5 g L^{-1} (200 g)	7.26	0.25	4.90	2.81
F_3 @ 7.5 g L^{-1} (300 g)	7.24	0.25	5.10	2.84
F_4 @ 10 g L^{-1} (400 g)	7.22	0.24	4.87	2.88
SE (m) ±	0.01	0.002	0.27	0.031
CD at 5%				
Humic acid (H)				
H_1 (control)	7.24	0.24	4.75	2.82

H_2 (500 ppm)	7.25	0.25	5.03	2.83
H_3 (750 ppm)	7.23	0.25	5.03	2.84
SE (m) ±	0.003	0.002	0.28	0.026
CD at 5%				
Interaction (F x H)				
SE (m) ±	0.02	0.007	0.38	0.043
CD at 5%				

Table 2: Interaction effect of water soluble fertilizer (19:19:19) and humic acid on physico-chemical properties of soil

Treatments	**pH**			
Fertilizer	**Humic acid**			
	H_1 (control)	**H_2 (500 ppm)**	**H_3 (750 ppm)**	**Mean**
F_1 Control	7.22	7.23	7.28	7.24
F_2 @ 5 g L^{-1} (200 g)	7.29	7.24	7.24	7.26
F_3 @ 7.5 g L^{-1} (300 g)	7.24	7.27	7.21	7.24
F_4 @ 10 g L^{-1} (400 g)	7.20	7.25	7.21	7.22
Mean	7.24	7.25	7.23	
	Factor A (F)	**Factor B (H)**	**Interaction (F X H)**	
SE (m) ±	0.01	0.003	0.02	
CD at 5%				

Treatments	**EC (dS m^{-1})**
Fertilizer	**Humic acid**

	H_1 (control)	H_2 (500 ppm)	H_3 (750 ppm)	Mean
F_1 Control	0.25	0.24	0.25	0.25
F_2 @ 5 g L^{-1} (200 g)	0.25	0.25	0.25	0.25
F_3 @ 7.5 g L^{-1} (300 g)	0.25	0.27	0.25	0.25
F_4 @ 10 g L^{-1} (400 g)	0.23	0.25	0.25	0.24
Mean	0.24	0.25	0.25	
	Factor A (F)	**Factor B (H)**	**Interaction (F X H)**	
SE (m) ±	0.002	0.002	0.007	
CD at 5%				

Treatments	**OC (g kg^{-1})**			
Fertilizer	**Humic acid**			
	H_1 (control)	**H_2 (500 ppm)**	**H_3 (750 ppm)**	**Mean**
F_1 Control	4.60	4.90	5.10	4.87
F_2 @ 5 g L^{-1} (200 g)	4.80	4.90	5.00	4.90
F_3 @ 7.5 g L^{-1} (300 g)	5.00	5.30	5.00	5.10
F_4 @ 10 g L^{-1} (400 g)	4.60	5.00	5.00	4.87
Mean	4.75	5.03	5.03	
	Factor A (F)	**Factor B (H)**	**Interaction (F X H)**	
SE (m) ±	0.27	0.28	0.38	
CD at 5%				

Treatments	**Calcium carbonate (%)**
Fertilizer	**Humic acid**

	H_1 (control)	H_2 (500 ppm)	H_3 (750 ppm)	Mean
F_1 Control	2.78	2.78	2.80	2.78
F_2 @ 5 g L^{-1} (200 g)	2.80	2.82	2.83	2.81
F_3 @ 7.5 g L^{-1} (300 g)	2.84	2.85	2.85	2.84
F_4 @ 10 g L^{-1} (400 g)	2.87	2.89	2.90	2.88
Mean	2.82	2.83	2.84	
	Factor A (F)	**Factor B (H)**	**Interaction (F X H)**	
SE (m) ±	0.031	0.026	0.043	
CD at 5%				

Effect of water soluble fertilizer and humic acid on residual fertility status of soil

The data revealed that the application of individual levels of water-soluble fertilizer and humic acid significantly increased the availability of nutrients in soil. Significantly, maximum available N in soil recorded in treatment F_4 with application of 400 g 19:19:19 (245.7 kg ha^{-1}) which is found to be at par with 300 g 19:19:19 (F_3) Similar finding was reported by Singh *et al.* (2015) in carnation. Whereas, maximum nitrogen (243.9 kg ha^{-1}) was found in treatment 750 ppm humic acid (H_3) which was at par with the treatment 500 ppm humic acid (H_2). Similar finding was reported by Patil (2020) stated that, humic acid application (soil + foliar) was significantly increased available nitrogen in soil. Data shows that available nitrogen in soil was found highest (254.8 kg ha^{-1}) in treatment 400 g 19:19:19 WSF and 500 ppm humic acid (F_4H_2) which was found to be at par with treatment F_1H_3, F_3H_1 and F_2H_3. These results are also in the line with the findings of Chen and Aviad (1990), who reported significant differences in nitrogen uptake

Table 3: Effect of water-soluble fertilizer (19:19:19) and humic acid on N, P, K and S status of soil

Treatments	Available N (kg ha^{-1})	Available P (kg ha^{-1})	Available K (kg ha^{-1})	Available S (kg ha^{-1})
Fertilizer (F)				
F_1 Control	234.4	13.41	258.2	12.23
F_2 @ 5 g L^{-1} (200 g)	239.1	13.62	258.7	12.41
F_3 @ 7.5 g L^{-1} (300 g)	243.9	13.74	261.3	12.48
F_4 @ 10 g L^{-1} (400 g)	245.7	13.82	262.0	12.57
SE (m) ±	1.83	0.05	0.64	0.04
CD at 5%	5.30	0.16	1.93	
Humic acid (H)				
H_1 (control)	235.6	13.47	256.5	12.32
H_2 (500 ppm)	242.7	13.72	261.8	12.44
H_3 (750 ppm)	243.9	13.74	261.7	12.51
SE (m) ±	1.33	0.04	0.86	0.03
CD at 5%	3.85	0.12	2.60	
Interaction (F x H)				
SE (m) ±	5.71	0.14	2.34	0.13
CD at 5%	11.56	0.41	6.78	

Table 4: Interaction effect of water soluble fertilizer (19:19:19) and humic acid on N, P, K and S status of soil

Treatments	Available nitrogen (kg ha^{-1})			
Fertilizer	**Humic acid**			
	H_1 (control)	**H_2 (500 ppm)**	**H_3 (750 ppm)**	**Mean**
F_1 Control	220.6	235.6	246.9	234.4
F_2 @ 5 g L^{-1} (200 g)	234.3	238.5	244.4	239.1
F_3 @ 7.5 g L^{-1} (300 g)	245.5	242.2	244.1	243.9
F_4 @ 10 g L^{-1} (400 g)	242.1	254.8	240.4	245.7
Mean	235.6	242.7	243.9	
	Factor A (F)	**Factor B (H)**	**Interaction (F X H)**	
SE (m) ±	1.83	1.33	5.71	
CD at 5%	5.30	3.85	11.56	

Treatments	Available phosphorus (kg ha^{-1})			
Fertilizer	**Humic acid**			
	H_1 (control)	**H_2 (500 ppm)**	**H_3 (750 ppm)**	**Mean**
F_1 Control	13.11	13.24	13.90	13.41
F_2 @ 5 g L^{-1} (200 g)	13.45	13.86	13.56	13.62
F_3 @ 7.5 g L^{-1} (300 g)	13.50	13.89	13.83	13.74
F_4 @ 10 g L^{-1} (400 g)	13.82	13.97	13.68	13.82
Mean	13.47	13.72	13.74	
	Factor A (F)	**Factor B (H)**	**Interaction (F X H)**	
SE (m) ±	0.05	0.04	0.14	
CD at 5%	0.16	0.12	0.41	

Treatments	Available potassium (kg ha^{-1})			
Fertilizer	**Humic acid**			
	H_1 (control)	**H_2 (500 ppm)**	**H_3 (750 ppm)**	**Mean**
F_1 Control	251.3	257.8	265.4	258.2
F_2 @ 5 g L^{-1} (200 g)	254.2	262.2	259.6	258.7
F_3 @ 7.5 g L^{-1} (300 g)	257.1	263.6	263.3	261.3
F_4 @ 10 g L^{-1} (400 g)	263.6	263.7	258.7	262.0
Mean	256.5	261.8	261.7	
	Factor A (F)	**Factor B (H)**	**Interaction (F X H)**	
SE (m) ±	0.64	0.86	2.34	
CD at 5%	1.93	2.60	6.78	

Treatments	Available sulphur (kg ha^{-1})			
Fertilizer	**Humic acid**			
	H_1 (control)	**H_2 (500 ppm)**	**H_3 (750 ppm)**	**Mean**
F_1 Control	11.97	12.26	12.47	12.23
F_2 @ 5 g L^{-1} (200 g)	12.34	12.50	12.40	12.41
F_3 @ 7.5 g L^{-1} (300 g)	12.45	12.49	12.51	12.48
F_4 @ 10 g L^{-1} (400 g)	12.53	12.49	12.68	12.57
Mean	12.32	12.44	12.51	
	Factor A (F)	**Factor B (H)**	**Interaction (F X H)**	
SE (m) ±	0.04	0.03	0.13	
CD at 5%				

The maximum available P in soil recorded in treatment F_4 with application of 400 g 19:19:19 (13.82 kg ha^{-1}) which was found to be at par with (F_3) 300 g 19:19:19 (13.74 kg ha^{-1}). Similar finding was reported by Singh *et al.* (2015) and Nirgulkar et al, (2020) in carnation. Significantly, maximum phosphorus (13.74 kg ha^{-1}) was found in treatment 750 ppm humic acid (H_3) which was at par with the treatment (H_2). Similar finding was reported by Patil (2020) stated that, humic acid application (soil + foliar) was significantly increased availability of phosphorus in soil. Data shows that available phosphorus in soil was found highest (13.97 kg ha^{-1}) in treatment 400 g 19:19:19 WSF and 500 ppm humic acid (F_4H_2) which was found to be at par with treatment F_3H_2, F_2H_2, F_3H_3, F_4H_1 and F_4H_3.

The maximum available K in soil recorded in treatment (F_4) with application of 400 g 19:19:19 (262.0 kg ha^{-1}) which was found to be at par with (F_3) 300 g 19:19:19 (261.32 kg ha^{-1}). Similar results were also obtained by Singh *et al.* (2015) who also reported increase in

available potassium in soil with increasing doses of potassium application. Significantly, maximum potassium (261.8 kg ha^{-1}) was found in treatment 500 ppm humic acid (H_2) which was at par with the treatment (H_3). Similar findings were reported by Patil (2020) reported that, humic acid application (soil + foliar) was significantly increased available potassium in soil. Data shows that available potassium in soil was found highest (263.7 kg ha^{-1}) in treatment 400 g 19:19:19 WSF and 500 ppm humic acid (F_4H_2) which was found to be at par with treatment F_3H_2, F_3H_3, and F_2H_2. Homogenous results showing the positive co-relationship between the doses of HA and the potassium contents of the leaves were observed by Nikbakht et al. (2008).

The available sulphur was found non-significant with individual application of water-soluble fertilizers and humic acid spray as well as in combination.

Conclusion:

The combine application of water-soluble fertilizer @ 300 g and humic acid @ 500 ppm increased the availability of nutrients in soil and improves fertility status of soil.

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