International Journal of Plant & Soil Science

Volume 37, Issue 1, Page 117-125, 2025; Article no.IJPSS.128839
ISSN: 2320-7035

Effect of Foliar Application of Water Soluble Fertilizer and Humic Acid on Physico-chemical Properties and Fertility Status of Soil after Harvest of Rose

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.9734/ijpss/2025/v37i15258

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/128839

Original Research Article

Received: 02/11/2024
Accepted: 07/01/2025
Published: 13/01/2025

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Cite as: *Bante, Rutuja S., Mayuri N. Ingole, and Vipul M. Pardhi. 2025. "Effect of Foliar Application of Water Soluble Fertilizer and Humic Acid on Physico-Chemical Properties and Fertility Status of Soil After Harvest of Rose". International Journal of Plant & Soil Science 37 (1):117-25. https://doi.org/10.9734/ijpss/2025/v37i15258.*

ABSTRACT

A field experiment on "Effect of foliar application of water soluble fertilizer and humic acid on yield and quality of *rosa sp* 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 water soluble fertilizer (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. The collected soil samples were processed and analysed for different soil parameter like soil pH, electrical conductivity, organic carbon, calcium carbonate, available nitrogen, available phosphorus available potassium and available sulphur using standard analytical methods. Results revealed that pH of all the samples of study area was in the neutral to alkaline. Electrical conductivity of all the samples were found normal (<1.0 dsm^{-1}). The organic carbon content of the study area varies from low to medium. The availability of NPK after harvesting was found superior in treatment combination (F_4H_3), which involved application of 400 g 19:19:19 with 750 ppm humic acid.

Keywords: Rose; water soluble fertilizer; humic acid; soil fertility.

1. INTRODUCTION

Rose is native of USA and belongs to the family Rosaceae. It is a woody perennial flowering plant of genus *Rosa.* 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 & 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 eye drops or eye wash in burning sensation of the eyes (Chahar, 2016). Water soluble fertilizer 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).

2. 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 ^{0} 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.

Sr. No.	Abbreviation used	Treatment combinations
1	F_1 H_1	Control- 0 g 19:19:19 + 0 ppm humic acid
2	F_1 H_2	0 g 19:19:19 + 500 ppm humic acid
3	F_1 H_3	0 g 19:19:19 + 750 ppm humic acid
4	F_2 H_1	200 g 19:19:19 + 0 ppm humic acid
5	F_2 H_2	200 g 19:19:19 + 500 ppm humic acid
6	F_2 H_3	200 g 19:19:19 + 750 ppm humic acid
7	F_3 H_1	300 g 19:19:19 + 0 ppm humic acid
8	F_3 H_2	300 g 19:19:19 + 500 ppm humic acid
9	F_3 H_3	300 g 19:19:19 + 750 ppm humic acid
10	F_4 H_1	400 g 19:19:19 + 0 ppm humic acid
11	F_4 H_2	400 g 19:19:19 + 500 ppm humic acid
12	F_4 H_3	400 g 19:19:19 + 750 ppm humic acid

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 & 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 & Black's (1934) Wet Oxidation method and Calcium carbonate was estimated by Rapid Titration method (Piper, 1966). Nitrogen content was determined as alkaline permaganate method described by Subbiah and Asija (1956), While phosphorus was estimated by using Olsen's method reagent (Olsen & 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 & Yien (1951). Data were statistically analysed in Factorial Randomised Block Design (Gomez & Gomez, 1984)

3. 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 (Tables 1 and 2).

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

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				EC (dS m^{-1})				OC (g kg^{-1})				Calcium carbonate (%)			
Fertilizer	**Humic acid**				**Humic acid**				**Humic acid**				**Humic acid**			
	H_1 (control)	**H_2 (500 ppm)**	**H_3 (750 ppm)**	**Mean**	**H_1 (control)**	**H_2 (500 ppm)**	**H_3 (750 ppm)**	**Mean**	**H_1 (control)**	**H_2 (500 ppm)**	**H_3 (750 ppm)**	**Mean**	**H_1 (control)**	**H_2 (500 ppm)**	**H_3 (750 ppm)**	**Mean**
F_1 Control	7.22	7.23	7.28	7.24	0.25	0.24	0.25	0.25	4.60	4.90	5.10	4.87	2.78	2.78	2.80	2.78
F_2 @ 5 g L^{-1} (200 g)	7.29	7.24	7.24	7.26	0.25	0.25	0.25	0.25	4.80	4.90	5.00	4.90	2.80	2.82	2.83	2.81
F_3 @ 7.5 g L^{-1} (300 g)	7.24	7.27	7.21	7.24	0.25	0.27	0.25	0.25	5.00	5.30	5.00	5.10	2.84	2.85	2.85	2.84
F_4 @ 10 g L^{-1} (400 g)	7.20	7.25	7.21	7.22	0.23	0.25	0.25	0.24	4.60	5.00	5.00	4.87	2.87	2.89	2.90	2.88
Mean	7.24	7.25	7.23		0.24	0.25	0.25		4.75	5.03	5.03		2.82	2.83	2.84	
	Factor A (F)	**Factor B (H)**		**Interaction (F X H)**	**Factor A (F)**	**Factor B (H)**		**Interaction (F X H)**	**Factor A (F)**	**Factor B (H)**		**Interaction (F X H)**	**Factor A (F)**	**Factor B (H)**		**Interaction (F X H)**
SE (m) ±	0.01	0.003	0.02		0.002	0.002	0.007		0.27	0.28	0.38		0.031	0.026	0.043	
CD at 5%																

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})				Available phosphorous (kg ha^{-1})				Available potassium (kg ha^{-1})				Available sulphur (kg ha^{-1})			
Fertilizer	**Humic acid**				**Humic acid**				**Humic acid**				**Humic acid**			
	H_1 (control)	**H_2 (500 ppm)**	**H_3 (750 ppm)**	**Mean**	**H_1 (control)**	**H_2 (500 ppm)**	**H_3 (750 ppm)**	**Mean**	**H_1 (control)**	**H_2 (500 ppm)**	**H_3 (750 ppm)**	**Mean**	**H_1 (control)**	**H_2 (500 ppm)**	**H_3 (750 ppm)**	**Mean**
F_1 Control	220.6	235.6	246.9	234.4	13.11	13.24	13.90	13.41	251.3	257.8	265.4	258.2	11.97	12.26	12.47	12.23
F_2 @ 5 g L^{-1} (200 g)	234.3	238.5	244.4	239.1	13.45	13.86	13.56	13.62	254.2	262.2	259.6	258.7	12.34	12.50	12.40	12.41
F_3 @ 7.5 g L^{-1} (300 g)	245.5	242.2	244.1	243.9	13.50	13.89	13.83	13.74	257.1	263.6	263.3	261.3	12.45	12.49	12.51	12.48
F_4 @ 10 g L^{-1} (400 g)	242.1	254.8	240.4	245.7	13.82	13.97	13.68	13.82	263.6	263.7	258.7	262.0	12.53	12.49	12.68	12.57
Mean	235.6	242.7	243.9		13.47	13.72	13.74		256.5	261.8	261.7		12.32	12.44	12.51	
	Factor A (F)	**Factor B (H)**		**Interaction (F X H)**	**Factor A (F)**	**Factor B (H)**		**Interaction (F X H)**	**Factor A (F)**	**Factor B (H)**		**Interaction (F X H)**	**Factor A (F)**	**Factor B (H)**		**Interaction (F X H)**
SE (m) ±	1.83	1.33	5.71		0.05	0.04	0.14		0.64	0.86	2.34		0.04	0.03	0.13	
CD at 5%	5.30	3.85	11.56		0.16	0.12	0.41		1.93	2.60	6.78					

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) that, humic acid application (soil + foliar) was significantly increased available nitrogen in soil. Data in Table 3 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 & Aviad (1990), who reported significant differences in nitrogen uptake.

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) 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 in Table 4 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 was reported by Patil (2020) reported that, humic acid application (soil + foliar) was significantly increased available potassium in soil. Data in Table 4 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) and Ingle et al., (2019).

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

4. CONCLUSION

The combine application of water soluble fertilizer @400 g and humic acid @ 750 ppm increased the availability of nutrients in soil and improves fertility status of soil. This synergistic effect highlights the importance of a balanced approach to nutrient management and the potential benefits of integrating organic and synthetic inputs for optimal crop performance.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

Angier, M., & Bradford, R. (1974). *Field guide to edible wild plants*. Stackpole Books. ISBN 0-8117-0616-8.

Chahar, M. (2016). Rose: Ornamental as well as medicinal plant. *Journal of Research in Agricultural and Animal Science, 4*(1), 8–10. Retrieved from www.questjournals.org

Chen, Y., & Aviad, T. (1990). Effects of humic substances on plant growth. In *Humic substances in soil and crop science: Selected readings* (pp. 161–186). Soil Science Society of America and American Society of Agronomy.

Chesnin, L., & Yien, C. H. (1951). Turbidimetric determination of available sulfate. *Soil Science Society of America Proceedings, 15*, 149–151.

Gomez, K. A., & Gomez, A. A. (1984). *Statistical procedures for agricultural research* (2nd ed.). John Wiley & Sons.

Ingle, S. N., Nagaraju, M. S. S., Sahu, N., Kumar, N., Tiwary, P., Srivastava, R., Sen, T. K., & Nasre, R. A. (2019). Soil fertility status of macro-nutrients and micro-nutrients in Bareli watershed of Seoni district, Madhya Pradesh, India.

International Journal of Chemical Studies, 6(4), 1950–1953.

Jackson, M. L. (1973). *Soil chemical analysis*. Prentice Hall of India.

Nikbakht, A. M., Kafi, M., Babalar, Y. P., Xia, A., Luo, A., & Etemadi, N. (2008). Effect of humic acid on plant growth, nutrient uptake, and postharvest life of *Gerbera*. *Journal of Plant Nutrition, 31*, 2155–2167.

Olsen, S. R., & Sommer, L. E. (1982). Phosphorus methods of soil analysis: Chemical and microbiological properties (Part 2, 2nd ed., pp. 403–430). Agronomy.

Patil, H. (2020). *Influence of humic acid on growth, yield, and quality of chrysanthemum (Dendranthema grandiflora L.) cv. Marigold* (Unpublished master's thesis). University of Agricultural Sciences, Bangalore.

Piper, C. S. (1966). *Soil and plant analysis*. Hans Publishers.

Sabzevari, S., Khazaie, H. R., & Kafi, M. (2008). Study on the effects of humic acid on germination of four wheat cultivars (*Triticum aestivum* L.). *Iranian Journal of Field Crops Research, 8*(3), 473–480.

Singh, A., Sharma, B. P., Dilta, B. S., Nomita Laishram, B. S., Gupta, Y. C., & Bharadwaj, S. K. (2015). Effects of fertilization on quality flower production and foliar nutrient content of carnation (*Dianthus caryophyllus* L.) cv. Master. *Bangladesh Journal of Botany, 44*(1), 133–137.

Singh, D. K., & Peter, K. V. (2014). *Protected cultivation of horticultural crops* (1st ed., p. 334). New Delhi.

Subbiah, B. V., & Asija, G. L. (1956). A rapid procedure for determination of available nitrogen in soil. *Current Science, 25*, 256–260.

Vibhute, C. P. (1998). A process for manufacturing complex solid and liquid completely water-soluble fertilizers. *Fertilizer News, 43*(8), 63.

Walkley, A. J., & Black, A. I. (1934). Estimation of organic carbon by chromic acid titration method. *Soil Science, 25*, 255–259.

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