EFFECT OF SOIL AND FOLIAR APPLICATION OF LHA ON GROWTH AND YIELD OF RADISH IN THREE TYPES OF SOIL

R. Bhuvaneswari*
K. Dhanasekaran**
S. Suganthi ***

*Department of Soil Science and Agricultural Chemistry, Faculty of Agriculture, Annamalai University, Annamalai nagar-608002

**Department of Genetics and Plant Breeding, Faculty of Agriculture, Annamalai University, Annamalai nagar-608002

***Department of Soil Science and Agricultural Chemistry, Faculty of Agriculture, Annamalai University, Annamalai nagar-608002

ABSTRACT

Radish is a root vegetable that resembles beet root or turnip in appearance and textures but have a distinct flavour. The specialty of the vegetable is that both root portion as well as the leaf portion can be used as vegetables. In the present study, an attempt was made to improve the productivity of radish by integrating humic acid extracted from lignite along with organic manures and inorganic fertilizers. The pot experiment was conducted to study the combined effect of soil and foliar application of humic acid on the growth and yield of Radish. Two best doses of LHA obtained in soil (30mg kgm^{-1}) and foliar application (0.3%) were selected from the previous pot experiments and tried in combination. Further, the effect of foliar application of micronutrients enriched LHA were also tested along with soil application of LHA. The experiment was conducted in completely randomized design (CRD) with fifteen treatments and each treatment was replicated six times The soil samples were collected from three different vegetable growing locations viz 1) Vallampadugai (TypicUstifluvents–Padugai(Pdg)series),2)Palur(FluvaroticUstropept–Vadalapakkam(Vdm)series) and 3) Virudhachalam (Typic Haplustalfs - Mangadu (Mgd) series) of Cuddalore district, Tamilnadu for conducting pot experiments. The initial soil samples were analyzed by adopting standard procedures to determine physico-chemical properties. Twenty kg of air-dried and processed soil was filled in 1x1 m^2 cement pots. A uniform NPK dose of 50:30:50 mg kg^{-1} was supplied through urea, superphosphate and muriate of potash (MOP). Radish var. Pusa chetki was grown as test crop. Four plants were maintained in each pot. The details of the treatments consisted of T_1 - Control, T_2 – LHA soil application 20 mg kg^{-1} , T_3 – LHA soil application 30 mg kg^{-1} , T_4 –LHA Foliar spray (0.2%), T_5 – LHA Foliar spray $(0.3\%)^1$, T_6 – LHA 0.2% +0.1% Zn ,0.2% Fe,0.1% Mn, 0.05% Cu, T_7 – LHA 0.3% + 0.1% Zn ,0.2% Fe,0.1% Mn,0,05% Cu, T_8 – , T_{2+} $T_{4,}$ T_9 – T_{2+} T_5 T_{10} – T_{3+} $T_{4,}$ T_{11} – T_{3+} $T_{5,}$ T_{12} – T_{2+} $T_{6,}$ T_{13} – T_{2+} $T_{7,}$, T_{14} – T_{3+} $T_{6,}$ T_{15} – T_{3+} $T_{7.}$Growth and yield parameters were recorded at appropriate stage of crop growth. The results of the study clearly revealed that Soil application of LHA is better than foliar spray for enhancing the growth and yield of radish. Foliar fertilization of micronutrient enriched LHA more favourably improved the yield as compared to foliar application of LHA alone.

Key Words: TypicUstifluvents– FluvaroticUstropept, Typic Haplustalfs, Radish, LHA

INTRODUCTION

Demand for vegetables also growing due to urbanization, globalization and increasing income level. To meet the growing needs of vegetables, it is projected that we need to produce 149 Mt in 2016. With the diverse agro-climatic conditions in the country, these targets are not very difficult to reach, provided an appropriate policy decisive environment is created Further, in view of changing food basket, diversified production of vegetables for sustainable increase in farm income and employment, promoting value addition and export, the role of vegetable becomes more important than the past.

The influence of world trade reforms has thrown up several new challenges in the demand and supply of vegetables particularly in India. Rapid urbanization, increasing per capita income, diversifying food basket in the demand front, declining size of the holding and falling trend of some scarce natural resources like soil and water have made the olericultural scientist to think of the ways and means for improving the productivity of vegetables without affecting the natural resources. Recently, several olericultural techniques like integrated nutrient management, use of improved high yielding varieties and improved cultivation practices have been adopted to maximize the yield of vegetables. Among these techniques, integrated nutrient management (INM) play a pivotal role because the success of other techniques depends on INM.

Vegetables being the heavy feeder of both macro and micronutrients require effective INM practices to improve the productivity as well as to sustain soil health.Though the organic manures are important component of INM and supplies both macro and micronutrients to plants, soil humus content could not be improved to a desired level in a short period by the application of organic manures. Hence, inclusion of humic substances in INM become an imperative need to develop an efficient INM practice for crops as well as to improve the soil quality.

Humic substances are very important component of soil that affect physical and chemical properties and improve soil fertility. They are complex and heterogenous mixture of poly dispersed materials formed by biochemical and chemical reactions during the decay and transformation of plant and microbial remains.

Radish have traditionally been eaten for constipation; this is because they supply high amount of indigestible carbohydrates. Partially due to their potassium content and as a mild diuretic, radish also helpful for kidney and urinary tract health. The health benefits of radish also aiding in digestion and liver health because of the presence of sulphur based phytochemicals which stimulate bile secretion. The glucosinate which are found in all cruciferous vegetables are believed to be the main anticarcinogenic agent in the food.

As compared to other vegetables only little attention has been paid on the development of integrated nutrient management practices to radish. Hence, the present study was planned with the objectives of to study the effect of soil and foliar appilication of LHA on growth and yield of radish in three types of soil.

MATERIALS AND METHODS

The pot experiment was conducted to study the combined effect of soil and foliar application of humic acid on the growth and yield of Radish. Two best doses of LHA obtained in soil (30mg kgm-1) and foliar application (0.3%) were selected from the previous pot experiments and tried in combination. Further, the effect of foliar application of micronutrients enriched LHA were also tested along with soil application of LHA. The experiment was conducted in completely randomized design (CRD) with fifteen treatments and each treatment was replicated six times. Twenty kg of air-dried and processed soil was filled in 1x1 m^2 cement pots. Calculated quantity of LHA was dissolved in 0.1 N KOH and the K-humate solution (pH $\simeq$ 7) was diluted with deionised water and applied to the pots as per the treatments. An uniform NPK dose of 50:30:50 mg kg^{-1} was supplied through urea, superphosphate and muriate of potash (MOP). Full dose of P and K and half dose of N were applied basally and the remaining 50% N was applied on 20 DAS. Radish var. Pusa chetki was grown as test crop. Four plants were maintained in each pot. The details of the treatments consisted viz T_1 - Control, T_2 – LHA soil application 20 mg kg^{-1} , T_3 – LHA soil application 30 mg kg^{-1} , T_4 –LHA Foliar spray (0.2%), T_5 – LHA Foliar spray (0.3%)[1], T_6 – LHA O.2% +0.1% Zn ,0.2% Fe,0.1% Mn, 0.05% Cu, T_7 – LHA 0.3% + 0.1% Zn ,0.2% Fe,0.1% Mn,0,05% Cu, T_8 – , T_{2+} $T_4$$T_9$ – T_{2+} T_5 T_{10} – T_{3+} $T_{4,}$ T_{11} – T_{3+} $T_{5,}$ T_{12} – T_{2+} $T_{6,}$ T_{13} – T_{2+} $T_{7,,}$ T_{14} – T_{3+} $T_{6,}$ T_{15} – T_{3+} $T_{7,}$

The soil samples were collected from three different vegetable growing locations: 1) Vallampadugai(TypicUstifluvents–Padugai(Pdg)series),2)Palur(FluvaroticUstropept–Vadalapakkam(Vdm)series) and 3) Virudhachalam (Typic Haplustalfs - Mangadu (Mgd) series) of Cuddalore district, Tamilnadu for conducting pot experiments. The initial soil samples were analyzed by adopting standard procedures to determine physico-chemical properties.

RESULTS AND DISCUSSION

Effect of soil and foliar application of LHA on the growth of radish (Table 1&2)

Application of LHA either through soil or foliar spray significantly increased the number of leaves plant^{-1} of radish. Between the two modes of application, soil application was found to be better than foliar spray. Combined application of humic acid along with micronutrient mixture showed a better performance in increasing the number of leaves as compared to their sole application of LHA in all the three soils tried.

Among the three soils, S_1 registered the maximum number of leaves both at 25 and 45 DAS followed by S_3. Interaction effect between soils and treatments on number of leaves was significant. The treatment which received LHA @ 30 mg kg^{-1} through soil application along with foliar spray of 0.2 per cent LHA + micronutrient mixture recorded the highest number of leaves of 14.3 ,16.5 and the highest leaf area of 208.1(cm^2) and 240.4(cm^2) on 25 and 45 DAS respectively at S_1. This trend was observed in all the three soils. This was followed by the treatments T_{15} and T_{12} in all the three soils. The lowest number of leaves was recorded in control. The complexing property of humic acids with micronutrients cations such as Zn, Fe, Mn, Cu is proved beyond doubt (Dekock, 1995; Beniaus *et al*., 1977). The micronutrient chelates profoundly and positively influences the availability, absorption and mobility of micronutrients within plant system. Dhanasekaran *et al*. (2008) Humic substances are known to improve cell wall permeability. Chelated micronutrient, being negatively charged ion, moves easily like other anions and reaches the growing point (Mirchandani, 1992). The improved absorption and translocation of micronutrients might be responsible for improved growth and yield of radish. Similar finding was observed in tomato and bhendi by Bhuvaneswari and Dhanasekaran (2007).

Effect of soil and foliar application of LHA on the yield parameters of radish.(Table3)

Length of tuber and shoot length of radish were favourably influenced by LHA application. Between the two modes of application, soil application was found to be better than foliar spray. Application of humic acid enriched with micronutrient mixture showed a better performance than foliar application of humic acid alone. Among the fifteen treatments, the treatment which received LHA @ 30 mg kg^{-1} as soil application along with foliar spray of 0.2 per cent LHA with micronutrient mixture was registered maximum length of tuber and shoot.

Among the three soils, S_1 recorded longest tuber and shoot of 27.1 cm and 32.1 cm respectively. Interaction effect due to soils and treatments was significant. Application of LHA @ 30 mg kg^{-1} through soil application along with LHA @ 0.2 per cent through foliar application with micronutrient mixture to S_1 recorded longest tuber and shoot length (35.8 cm and 43.1 cm). This was closely followed by treatment which received LHA @ 30 mg kg^{-1} along with LHA @ 0.3 per cent + micronutrient mixture through foliar application. The lowest tuber and shoot length of 20.2 cm and 25.2 cm are noticed in control (S_2 and S_3) which did not receive any LHA application.

Effect of soil and foliar application of LHA on the single tuber weight and tuber yield of radish.(Table 4)

Irrespective of the mode of application, single tuber weight of radish was positively influenced by the application of LHA. Between the two modes of applications, soil application was found to be better than foliar spray. But, combined application of soil and foliar spray found to be superior than sole application of LHA either through soil or foliar spray. Foliar application of micronutrient enriched LHA performed better than LHA foliar spray.

Among the treatments, foliar application of LHA @ 0.2 per cent to plants supplied with LHA @ 30 mg kg^{-1} through soil application recorded the highest mean tuber weight. This was followed by treatment (T_{15}).

Among the three soils, S_1 recorded the highest mean tuber weight (224.3 g plant^{-1}) and higher mean tuber yield (898.2 g pot^{-1}) as compared to other two soils. Interaction effect due to treatments and soils was significant. Application of LHA @ 30 mg kg^{-1} through soil application and foliar application of LHA @ 0.2 per cent + micronutrients mixture registered the maximum tuber weight (308.2 g plant^{-1}) and tuber yield (1234.3 g pot^{-1}) in S_1. This was followed by S_3T_{14} .The control recorded the lowest tuber weight of 140.2 g plant^{-1} and tuber yield of 563.2 g pot^{-1}.

In Pot experiment, foliar application of LHA either alone or in combination with micronutrient significantly increased the growth and yield of radish. The yield improvement was highly significant when LHA was applied along with micronutrients. The essentiality of micronutrients for the crop growth is an established fact. They enter into the constituent of several plant enzymes that regulates many metabolic functions in plants. Besides, it is needed for the formation of growth promoting substances like auxin. For example, the involvement of zinc in the production of auxin from tryptophane was explained by several workers (Skoog, 1940).

CONCLUSION

Pot experiment was conducted to establish the best mode of application of LHA as well as to study the effect of foliar fertilization of micronutrient enriched LHA on radish. The outcome of the study revealed that soil application of LHA is better than foliar spray for improving the growth and yield of radish. Foliar fertilization with micronutrient enriched LHA significantly increased the leaf number, leaf area, tuber length, single tuber weight and tuber yield as compared to foliar application of LHA alone.

The treatment which received LHA @ 30 mg kg^{-1} as soil application along with foliar spray of micronutrient enriched LHA (0.2%) registered maximum number of leaves, leaf area and tuber yield of radish.

Table-1
Effect of soil and foliar application of LHA on the number of leaves plant^{-1} at 25 DAS and 45 DAS of radish

Treatments \ Soil	25 DAS				45 DAS			
	S_1	S_2	S_3	Mean	S_1	S_2	S_3	Mean
T_1 – Control	7.0	7.0	7.1	7.03	11.0	10.8	11.0	10.93
T_2 – LHA soil application 20 mg kg^{-1}	11.3	10.6	11.0	10.97	13.2	12.9	13.0	13.03
T_3 – LHA soil application 30 mg kg^{-1}	11.8	11.2	11.5	11.50	13.6	13.2	13.3	13.37
T_4 – LHA foliar spray (0.2%)	10.3	10.0	10.1	10.13	12.9	12.4	12.5	12.60
T_5 – LHA foliar spray (0.3%)	9.3	9.0	9.3	9.20	12.5	12.0	12.3	12.27
T_6 – LHA 0.2% + micronutrient mixture	12.2	12.0	12.0	12.07	13.7	13.2	13.3	13.40
T_7 – LHA 0.3% + micronutrient mixture	12.0	11.5	11.7	11.73	13.2	12.9	13.0	13.03
$T_8 – T_2 + T_4$	12.4	11.9	12.0	12.10	14.0	13.0	13.5	13.50
$T_9 – T_2 + T_5$	12.6	12.2	12.4	12.40	14.5	14.0	14.2	14.23
$T_{10} – T_3 + T_4$	13.2	12.8	13.0	13.00	15.0	14.0	14.7	14.57
$T_{11} – T_3 + T_5$	13.0	12.8	12.9	12.90	14.7	14.2	14.3	14.40
$T_{12} – T_2 + T_6$	13.6	13.2	13.4	13.40	15.8	15.2	15.5	15.50
$T_{13} – T_2 + T_7$	13.4	13.0	13.0	13.13	15.3	15.0	15.2	15.17
$T_{14} – T_3 + T_6$	14.3	13.5	14.0	13.93	16.5	16.0	16.2	16.23
$T_{15} – T_3 + T_7$	14.0	13.3	13.5	13.60	16.0	15.6	15.8	15.80
Mean	12.03	11.60	11.79		14.13	13.63	13.85	

	SEd	CD (p=0.05)	SEd	CD (p=0.05)
LHA	0.21	0.42	0.28	0.56
Soil	0.12	0.24	0.16	0.32
LHA x Soil	0.37	0.73	0.49	0.98

Table-2

Effect of soil and foliar application of LHA on the leaf area (cm^2) at 25 DAS and 45 DAS of radish

Treatments \ Soil	25 DAS				45 DAS			
	S_1	S_2	S_3	Mean	S_1	S_2	S_3	Mean
T_1 – Control	105.0	100.0	103.0	102.7	160.2	157.3	160.2	154.5
T_2 – LHA soil application 20 mg kg^{-1}	164.5	154.4	160.1	159.7	192.1	187.9	189.4	189.7
T_3 – LHA soil application 30 mg kg^{-1}	171.9	163.2	167.6	167.5	198.2	192.2	193.8	194.8
T_4 – LHA foliar spray (0.2%)	150.0	145.7	147.1	147.6	187.8	180.6	182.1	183.6
T_5 – LHA foliar spray (0.3%)	135.5	131.1	135.3	134.1	182.1	174.6	179.2	178.8
T_6 – LHA 0.2% + micronutrient mixture	177.7	174.5	174.1	175.7	199.5	192.3	193.8	195.3
T_7 – LHA 0.3% + micronutrient mixture	174.9	167.4	170.4	170.9	192.3	187.5	189.3	189.7
T_8 – T_2 + T_4	180.6	173.4	174.3	176.3	204.0	189.4	196.7	196.7
T_9 – T_2 + T_5	183.4	177.8	180.2	180.5	211.2	204.2	206.9	207.3
T_{10} – T_3 + T_4	192.3	186.5	189.1	189.4	218.5	204.6	214.2	212.3
T_{11} – T_3 + T_5	189.1	185.2	187.3	187.6	214.1	206.1	208.3	209.8
T_{12} – T_2 + T_6	198.1	192.1	195.2	195.2	230.1	221.3	225.8	225.8
T_{13} – T_2 + T_7	195.0	189.1	189.4	191.3	222.9	221.0	221.4	221.0
T_{14} – T_3 + T_6	208.1	196.1	204.0	202.8	240.4	233.1	236.0	236.4
T_{15} – T_3 + T_7	204.0	193.8	196.3	198.2	233.1	227.3	230.2	230.2
Mean	175.1	169.0	171.8		205.2	198.6	201.8	

	SEd	CD (p=0.05)	SEd	CD (p=0.05)
LHA	0.21	0.42	0.28	0.56
Soil	0.12	0.24	0.16	0.32
LHA x Soil	0.37	0.73	0.49	0.98

Table-3
Effect of soil and foliar application of LHA on the root length and shoot length of radish

Treatments \ Soil	Root length (cm)				Shoot length (cm)			
	S_1	S_2	S_3	Mean	S_1	S_2	S_3	Mean
T_1 – Control	20.2	20.0	20.0	20.1	25.2	25.0	25.0	25.1
T_2 – LHA soil application 20 mg kg^{-1}	23.0	22.2	22.5	22.6	28.0	26.0	26.8	26.9
T_3 – LHA soil application 30 mg kg^{-1}	24.2	23.4	23.7	23.8	29.2	27.2	28.0	28.1
T_4 – LHA foliar spray (0.2%)	22.4	21.6	21.9	22.0	27.4	25.4	26.2	26.3
T_5 – LHA foliar spray (0.3%)	21.6	20.8	21.1	21.2	26.6	24.6	25.4	25.5
T_6 – LHA 0.2% + micronutrient mixture	25.2	24.4	24.7	24.8	30.2	28.2	29.0	29.1
T_7 – LHA 0.3% + micronutrient mixture	24.8	24.0	24.3	24.4	29.8	27.8	28.6	28.7
T_8 – T_2 + T_4	26.8	26.0	26.3	26.4	31.8	29.8	30.6	30.7
T_9 – T_2 + T_5	27.3	26.5	26.8	26.9	32.3	30.3	31.1	31.2
T_{10} – T_3 + T_4	29.4	28.6	28.9	29.0	34.8	32.8	32.6	33.4
T_{11} – T_3 + T_5	29.0	28.2	28.5	28.6	34.2	32.2	33.0	33.1
T_{12} – T_2 + T_6	32.4	31.6	31.9	32.0	37.3	35.3	36.1	36.2
T_{13} – T_2 + T_7	30.0	29.2	29.5	29.6	35.0	33.0	33.8	33.9
T_{14} – T_3 + T_6	35.8	35.0	35.3	35.4	43.1	39.3	40.1	40.2
T_{15} – T_3 + T_7	33.6	32.8	33.1	33.2	38.6	36.6	37.4	37.5
Mean	27.1	26.3	26.6		32.1	30.2	30.9	

	SEd	CD (p=0.05)	SEd	CD (p=0.05)
LHA	0.65	1.30	0.55	1.09
Soil	0.38	0.75	0.31	0.63
LHA x Soil	1.14	2.26	0.95	1.89

115

Table-4
Effect of soil and foliar application of LHA on the tuber weight and dry matter production of radish

Treatments \ Soil	Tuber weight (g $plant^{-1}$)				Tuber yield (g pot^{-1})			
	S_1	S_2	S_3	Mean	S_1	S_2	S_3	Mean
T_1 – Control	140.6	140.2	140.0	140.2	566.2	560.0	563.4	563.2
T_2 – LHA soil application 20 mg kg^{-1}	176.4	170.6	173.9	173.6	706.5	684.2	693.2	694.6
T_3 – LHA soil application 30 mg kg^{-1}	188.3	182.6	185.8	185.6	755.2	732.6	742.3	743.4
T_4 – LHA foliar spray (0.2%)	164.5	158.8	162.0	161.8	658.0	636.4	643.2	645.9
T_5 – LHA foliar spray (0.3%)	152.4	146.7	149.9	149.7	610.6	588.6	594.5	597.9
T_6 – LHA 0.2% + micronutrient mixture	212.4	206.7	209.9	209.7	848.4	825.3	839.6	837.8
T_7 – LHA 0.3% + micronutrient mixture	200.3	194.6	197.8	197.6	802.4	772.3	791.2	788.6
$T_8 – T_2 + T_4$	224.0	218.3	221.5	221.3	898.2	873.2	885.2	885.5
$T_9 – T_2 + T_5$	236.2	230.5	233.7	233.5	945.8	920.7	935.4	934.0
$T_{10} – T_3 + T_4$	260.3	254.6	257.8	257.6	1041.2	1018.4	1031.2	1030.2
$T_{11} – T_3 + T_5$	248.4	242.7	245.9	245.7	994.6	970.8	983.4	982.9
$T_{12} – T_2 + T_6$	284.2	278.5	281.7	281.5	1138.2	1114.6	1126.8	1126.5
$T_{13} – T_2 + T_7$	272.3	266.6	269.8	269.6	1089.4	1066.8	1079.2	1078.5
$T_{14} – T_3 + T_6$	308.2	302.5	305.7	305.5	1234.3	1210.5	1222.6	1222.6
$T_{15} – T_3 + T_7$	296.0	290.3	293.5	293.3	1184.0	1159.3	1174.0	1.172.4
Mean	224.3	218.9	221.9		898.2	875.5	887.0	

	SEd	CD (p=0.05)	SEd	CD (p=0.05)
LHA	6.10	12.08	15.52	33.02
Soil	3.52	6.97	9.93	20.14
LHA x Soil	10.57	20.93	29.08	59.53

REFERENCES

Beniaus, G., P. Securon and G.R. Fithugh. 1977. Concentrations and activities of ions in solutions displaced from basaltic soils. **J. Soil Sci., 28**: 454-461.

Bhuvaneswari, R. and K. Dhanasekaran. 2007. Effect of soil application of humic acids on the growth and yield of radish (*Raphanus sativus* L.). **Plant Archives, 7**(2): 595-597.

Dekock, P.C. 1995. Influence of humic acids on plant growth. **Sci., 121**: 473-474.

Dhanasekaran, K., R. Bhuvaneswari, K. Sivakumar and S. Sathiyamurthi. 2008. Effect of soil application of humic acid on the growth and yield of Bhendi. **Internat. J. Trop. Agric., 26**(3-4): 297-299.

Mirchandani, T.B. 1992. Use of multimicronutrient fertilizers with chelating agent agromin on horticulture crops: A scientific study. **Micronutrient News,5**(10,11,12): 1-12.

Skoog, E. 1940. Relations between zinc and auxin in the growth of higher plants. **Amer. J. Bot., 27**: 939-951.