Science Research Reporter, 4(1): 57-63, (April - 2014)
© RUT Printer and Publisher (http://jsrr.net)
ISSN: 2249-2321 (Print); ISSN: 2249-7846 (Online)
Received: 01-02-2014, Revised: 22-02-2014, Accepted: 25-03-2014

Full Length Article

Effect of additional phosphate on growth, biomass and P uptake in *Lagerstroemia lanceolata* Wall. Ex. C. B inoculated with AM fungi

H C Lakshman and Kiran P Kolkar*

P.G Department and Studies in Botany, Microbiology Laboratory,
Karnatak University, Dharwad-580 003 India.
*Department of Botany, Karnatak Science CollegeDharwad
dr.hclakshman@gmail.com

ABSTRACT

Greenhouse experiments were undertaken to study the effect of the two AM fungal inoculation with three levels of K_2HPO_4; 50mg/kg, 100mg/kg and 150mg/kg on *Lagerstroemia lanceolata*. The results revealed that plants received AM fungal inoculation showed increased P content in shoots after 120 days. Plants grown after the inoculation of AM fungi showed significantly increased plant height, root length, leaf area and chlorophyll content with 100mg/kg compared to non-inoculated plants after 120 days. However, the percent root colonization and AM fungal spore number drastically reduced in Gm+Gl+3P level treated plants. It can be concluded that there is need of pre-inoculation in AM fungi with low balanced level of phosphorous treatment to forest/timber nursery seedlings, before they transplanted into the field.

Keywords: *Lagerstroemia lanceolata*, *Glomus leptonica*, *Glomus mosseae*, phosphorous treatment, per cent root colonization, Arbuscular mycorrhizal (AM) fungi.

INTRODUCTION

The productivity of tropical forest is decreasing to a considerable extent which poses manifold problems to restore the ecosystems. Increasing pressure of human and livestock population, indiscriminate extraction of forest products, regular fire and mining activities developed many issues in forest areas for reclamation and restoration of forest ecosystem. Some beneficial microbes are present in soil, which promote plant growth by providing access to the nutrient absorption, nitrogen fixation or synthesizing some growth promoting substances to the plants by different processes. Among these organisms, Arbuscular mycorrhizal (AM) fungi play an important role in nutrient uptake and P absorption. Mycorrhiza colonized plants have resistance against disease. They are equally important in reclamation of mine soils (Jamaluddin, 2002; Lakshman, 2005; Romana and Lakshman, 2009).

Agricultural and horticultural crops have been shown to benefit from AM fungi on a wide rouge of plant roots Mosse, 1973. Howeler *et al.,* 1987; Lakshman, 1996). Katiyar *et al*., (1995) haveanalyzed the effect of AM fungus (*Glomus fasciculatum*) along with phosphate level on the growth of *Morus alba.* Similarly, Karthikeyan *et al*., (2009) analysed the effect of *Glomus mosseae* along with phospnate levels on the growth and alkaloid content *Catharauthus rosea* L.

Lagerstroemia lanceolata, is an important timber yielding tree cultivated in Indian forests. As per the literature there is no report of AM fungal studies on this plant. The present study was carried out to understand the effect of AM fungi a *Lagerstroemia lanceoleta* with respect to growth biomass production percent root colonization and phosphorus content in shoot under three different phosphate levels over non-inoculated plants.

MATERIALS AND METHODS

Seeds of *Lagerstroemia lanceoleta* obtained from the department of forest Government of Karnataka, Sirsi – North Canara district. AM fungi *Glomus mosseae* and *G leptonica* pure culture was maintained on Maize as a host plant and kept in the polyhouse, department of Botany Karnatak University. Experimental pots measuring (30cm×30cm) diameter filled with 4kg of soil (equal proportion of pure sand and sterilized garden loamy Soil) 10g mixed inoculum was used, which containing rhizosphere soil of maize (host) and AMF colonized root pieces, hyphae and AM fungal spores (15-20 spores/ g of soil). Inoculum was placed 4cm below the surface of each pot. Healthy *L. lanceolata* seeds surface were sterilized in 2% sodium hypochlorite, soaked in water for 12 hrs and sowed in experimental pots. These pots were arranged in completely randomized block design with 4 replicates. One month – old seedlings of *L. lanceolata* were used with mycorrhiza incoluated and maintained with non inoculated plants. *Lagerstroemia lanceolata* plants with three phosphate levels (K_2HPO_4: 50mg, 100mg and 150mg in 100ml of distilled water.) P treatment was given at 7 days interval, and it was continued till the last observation was taken. Observations were made after 60, 90 and 120 days after AM fugal inoculation.

Roots and rhizosphere soil sample were collected from plants. AM fungal spores were recovered by wet sieving and decanting method (Gerdemann and Nicolson, 1963).Roots were transferred in to 10% KOH solution and heated at 90^0C degree for one hour and the time period was adjusted according to root bit delicacy. KOH was poured off and roots were rinsed with tap water. These bits were taken out and acidified by placing in 1% Hcl solution washed with distilled water, stained in 0.05 tryphan blue in lactophenol. Phillips and Hayman, 1973)

Horizontal and vertical grid lines were scanned and total number of roots bits intersecting grid line and total numbers of intersections involving infected roots bits were recorded.

The percent of root colonization was calculated by the formula:-

$$\textbf{Root colonization } (\%) = \frac{\text{Total No. of infected roots}}{\text{Total Number of roots}} \text{ X } 100$$

Phosphorous content of shoots was determined by Vandomolybolate phosphoric yellow color method (Jackson, 1973). The other parameters such as plant height, root length, leaf area, shoot dry weight, chlorophyll content of leaves, percent colonization and AM fungal spores were measured on each harvest of 60,90, and 120 days by adopting required scientific procedures.

RESULTS AND DISCUSSION

Factors that can contribute to their survival and performance of essential activities are microbial adaptability, adequate soil management and use of the minimum effective dosage of the fertilizers. Sustainability of soil and the plant systems requires good development and function of mycorrhizal symbiosis. Applications of easily soluble fertilizers especially phosphorus fertilizer increase the fraction of easily soluble fertilizers especially phosphorus fertilizers increase the fraction of easily available phosphorus in arable soils, but this is negatively correlated with presence of AM fungi

Arbuscular mycorrhizal fungal inoculation had a significant positive effect, on *Lagerstroemia lanceolata* plant growth with different parameters is shown in Tables (1 and 2).The results revealed that plants grown after the inoculation of AM fungi have higher biomass than non-inoculated (control). Plants height and root length was increased significantly in both AM Fungi inoculation with 100mg p/1 phosphate treatments when compared to centre (plants with 100mg P/kg phosphate treatment after 60, 90, and 120 days, with mycorrhizal fungal inoculation (Table 1). *L. lanceolata plant s*inoculated with phosphate treatment brought an increased shoot length and root length as compared to non inoculated plants shown in fig 1. This may be attributed to either mechanisms of mycorrhizal infection and development in the host tissue (Kormanic *et al*., 1982) or the improvement in phosphate uptake as a result of AM fungal infection (Jeffries, 1987; Lakshman, 1996). Similar, observation were made by (Chiramel*et al*., 2006) who have reported that plants inoculated with *Glomuse tunicatum*, G. *Leptonica* and *G. mosseae*, showed higher plant growth compare to non inoculated plants. The present findings are in agreement with (Elahi *et al*., 2010; Irfan *et al.,* 2011), who have documented

Table 1. Effect of AM fungi *Glomus mossease* and *G. leptionica* and three phosphate level treatments on *Lagerstroemia lanceolata* with respect to plant height, root length, leaf area and shoot dry weight for 120 days.

Days	Phosphate level	Shoot length (cm)	Root length (cm)	Leaf area (cm^2)	Shoot Dry weight (g)
60	C -50mg/kg soil	12.1±2.0	7.0 ±0.0	27.4 ± 2.0	0.56±0.5
90	C -50mg/kg soil	14.2±0.0	7.9 ± 1.0	31.2 ± 5.0	1.13 ±0.1
120	C -50mg/kg soil	21.4±1.2	10.0 ±2.0	38.0 ±0.3	1.54 ±2.6
60	C+1P	15.3±5.0	8.01 ± 0.2	33.1± 5.3	0.68 ±0.1
90		22.6±3.3	11.0 ± 0.2	42.0 ± 2.2	1.51 ±0.7
120		25.2 ±1.0	11.9 ± 1.5	44.5 ± 0.7	1.63±0.5
60	C+2P	16.8 ±5.0	9.2 ± 0.4	36.1 ± 0.1	0.91 ±0.4
90		23.1 ±2.4	12.0 ± 0.0	42.5 ± 0.4	1.52 ±1.6
120		30.0±0.0	13.7 ±1.3	46.1 ±2.6	2.61 ±0.4
60	C+3P	19.7±3.1	11.3 ± 1.5	39.2± 3.0	2.7 ±2.3
90		28.0±1.0	14.2 ± 1.0	44.0 ±0.0	2.63 ±7.2
120		31.5±2.2	17.1 ± 2.0	48.1 ±5.0	2.51 ±0.6
60	Gm+Gl	26.1±4.1	13.1 ±1.4	45.5 ±6.3	2.71 ±0.2
90		32.4±1.0	15.6 ± 3.0	51.0 ±2.3	2.82 ±4.0
120		35.8±7.2	18.8 ±2.2	55.2 ±0.1	2.63 ±3.1
60	Gm+Gl +1P	25.7 ±2.0	15.1 ± 1.0	46.5 ±6.2	2.76±2.0
90		33.1±0.5	19.2 ± 2.2	56.5 ± 3.2	2.55 ±1.5
120		37.51±3.1	21.2 ± 0.5	61.1 ±5.0	2.99 ±2.3
60	Gm+Gl +2P	29.3±4.4	16.4 ± 2.5	52.0 ±2.2	2.51 ±6.0
90		46.1±4.0	19.7 ± 2.0	60.0 ±0.5	2.93 ±0.7
120		49.8±1.5	21.1 ±0.3	62.6± 0.3	3.43 ±3.0
60	Gm+Gl +3P	31.2±7.1	17.3 ± 2.5	54.1 ±2.1	2.60±7.0
90		39.5±2.0	19.0 ± 0.4	62.6 ±0.8	2.62 ±3.3
120		38.0±0.2	18.4 ± 1.0	64.0 ± 0.3	2.50±0.0

C= control ; C+1P= control with first phosphate level (50mg/kg soil) C+2P =control with second phosphate level (100 mg P kg soil), C+3P = control with third phosphate level (150mg P/ kg soil), Gm+Gl = *Gomus mosse* + *G leptonica,* Gm+Gl+1P = *Glomus mosse* + *G. leptonica* with (50mg/kg soil) Gm+Gl +2P=*Glomus mosseae* + *G leptonica* with (100 mg/kg soil), Gm+Gl+3P = *G. mosseae* + *leptonica* with (150 mgP/kg soil).

the effect of inoculation with AM fungi a growth and total biomass of *S. melongena* at high phosphate level treatment (Gm+Gl+3P). Similarly *Lagerstroemia lanceolata* plants showed decreased shoot and root length as compared to (Gm+Gl+ 2P) after 120 days of AM fungal inoculation. Plants received AM fungal inoculation showed increased total chlorophyll content in leaves and P level in shoots (Fig 2). After 120 days AM fungal inoculation, dry weights of shoots drastically decreased in Gm+Gl+3P level treated to plants of *Lagerstroemia lanceolata* as compared to non - mycorrhizae inoculated plants because at high phosphate level, plants growth slowly suppressed due to which there is reduced accumulation of minerals in mycorrhizal plants shown in Table (1) Similar, results were obtained by earlier workers (Rubio *et al.,* 2003; Lakshman and Kolkar, 2008). Percent mycorrhizal colonization increased with an increased in phosphate level inearly stages of root colonization (Table 2). There was significantly increase in the percent root colonization at 60 and 90 days with *G. mosseae* and *G. leptonica* inoculation. But, there was a decreased per cent root colonization after 120 days when, the plants receive (Gm+Gl+3P level), because of high P concentration in the rhizosphere soil. It is reported that high soil P level reduces both intraradical as well as extraradical AM fungal development (Abbott and Robson, 1984; Liu *et al.,* 2000; Roopa and Lashman, 2009, Hosamani *et al.,* 2011). Total chlorophyll content consequently increased in AM inoculated plants than those of non-mycorrhiza inoculated (control) plants at first and second level

Table -2 Effect of AM fungi *G. mosse and G. leptonica* and three phosphate level treatment on *Lagerstroemia lanceolata* with regard to chlorophyll content in leaves, phosphate content in shoot, per cent root colonization and spore number for 120 days.

Days	Phosphate level	Phosphate content	Total Chlorophyll Mg/g	Percent root-colonization	AMF spores 50g.soil
60	C-50mg/kg soil	0.34 ± 0.0	0.46 ±0.2	0.00	0.00
90	C-50 mg/kg soil	0.71 ±0.1	1.72 ±3.1	0.00	0.00
120	C-50mg/kg soil	0.73 ±0.0	1.44 ±2.0	0.00	0.00
60	C+1P	0.56 ±1.0	0.96 ±0.4	0.00	0.00
90		1.22 ±0.8	1.36 ±5.3	0.00	14±0.5
120		1.48 ±0.2	1.54 ±4.7	0.00	19±1.3
60	C+2P	0.59 ±1.0	1.62 ±5.1	0.00	26±2.6
90		1.33 ±0.0	1.55 ±0.4	0.00	10±1.4
120		1.78 ±0.3	1.69 ±5.5	0.00	09±0.3
60	C+3P	0.66 ±0.9	1.29 ±4.3	0.00	11. ±5.0
90		1.57 ±0.1	1.62 ±6.2	0.00	14±2.0
120		1.81 ±9.0	1.73 ±7.1	0.00	13±1.1
60	Gm+Gl	0.77 ±1.1	1.51 ±8.0	53±7.0	79±5.0
90		1.10 ±0.0	2.14 ±6.2	56±4.0	62±9.2
120		1.42 ±0.7	3.62 ±4.5	59±0.5	61±5.0
60	Gm+Gl +1P	0.98 ±0.1	2.51 ±5.0	61±0.7	53±2.4
90		1.51 ±0.0	3.31 ±4.0	58±1.4	59±3.3
120		1.98 ±1.6	3.47 ±5.5	52±1.2	63±5.1
60	Gm+Gl +2P	1.16 ±7.0	2.85 ±6.7	48±4.0	61±0.2
90		1.63 ±0.0	3.38 ±0.8	43±3.2	58±1.1
120		2.11 ±0.5	3.64 ±4.1	42±5.1	53 ±1.3
60	Gm+Gl +3P	1.19 ±0.4	2.86 ±5.0	47±2.2	51 ±0.7
90		2.21 ±0.8	3.36 ±4.2	46±8.3	49±5.1
120		2.14 ±0.1	3.42 ±2.3	44±4.6	49±7.4

C= control ; C+1P= control with first phosphate level (50mg/kg soil) C+2P =control with second phosphate level (100 mg P kg soil), C+3P = control with third phosphate level (150mg P/ kg soil), Gm+Gl = *Gomus mossea* + *G leptonica,* Gm+Gl+1P = *Glomus mosse* + *G. leptonica* with (50mg/kg soil) Gm+Gl +2P=*Glomus mosseae* + *G leptonica* with (100 mg/kg soil), Gm+Gl+3P = *G. mosseae* + *leptonica* with (150 mgP/kg soil).

phosphate treatment i.e. (50-100 mg P/kg soil) and after 120 days of AM fungal inoculation. However, at high phosphate level (150mgP/kg soil), the total chlorophyll content was decreased in AM fungi inoculated plants (Gm+Gl+3P) after 120 days of inculcation, which is mainly that mycorrhizal colonization or P Fertilization influenced the concentration of photosynthetic pigments shown in Table. 2 These results are in agreement with earlier contributors (Giri*et al.,* 2003; Kapoor and Bhatnagar, 2007; Irfan*et al.,* 2011) present findings recorded that P content increased significantly anAM fungal inoculated *Lagerstroemia lanceolata* as compared to non-mycorrhizal plants. P content in shoots increased after 60,90 and 120 days after AM fungal inoculation in all the phosphated treatments (Table 2). The increased P uptake many be a result of increased phosphorylase activity on the surface of mycorrhizal roots. It may be also due to the increased absorbing area. Contributed by fungal hyphae (Pearson and Tinker, 1975).

The progress was observed to be a greater in AM fungal inoculated plants turn in non AMF inoculation, it was found to be more pronounced in (Gm+Gl+3P) as compared to (C+3P) treatment (Table 2). The present work with results is in agreement with the findings of (Liu, 2000; Dhanda *et al.,* 2004; Irfan*et al.,* 2011). Who have reported that plants which received AM fungal inoculation had higher phosphorus content in shoots than in non-AM fungal plants. The recent study clearly revealed that the plants of *Lagerstroemia lanceolata* received AM fungal inoculation, exhibited a significant growth in plant heights, roots length chlorophyll content in leaves, leaf area and P (control) plants. This suggests that AM fungi with balanced phosphate treatment con certainly prove beneficial for increasing biomass production in agricultural and Horticultural crops. Therefore, proper selection of indigenous mycorrhizal strains could playan important role in optimizing the growth of *Lager stroemia lanceolata.*

Fig 1.Effect of AM fungiand three phosphate level treatment on *Lagerstroemia lanceolata* with respect to plant height and root length for 120 days.

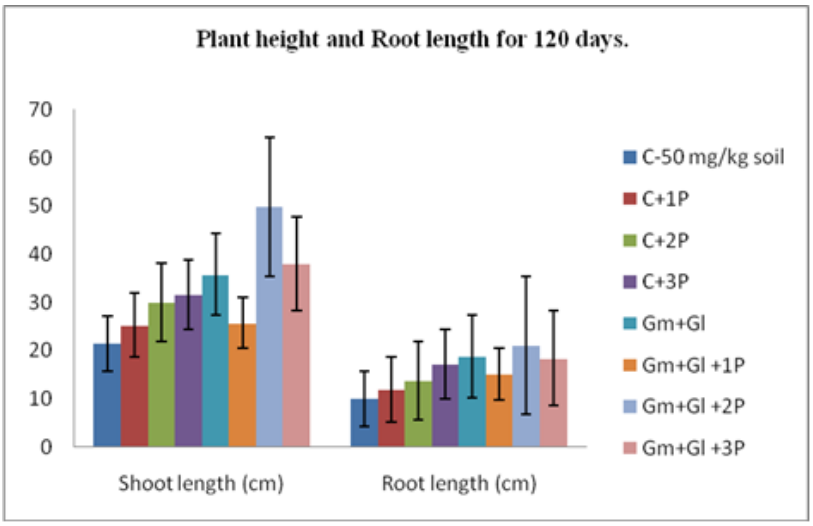
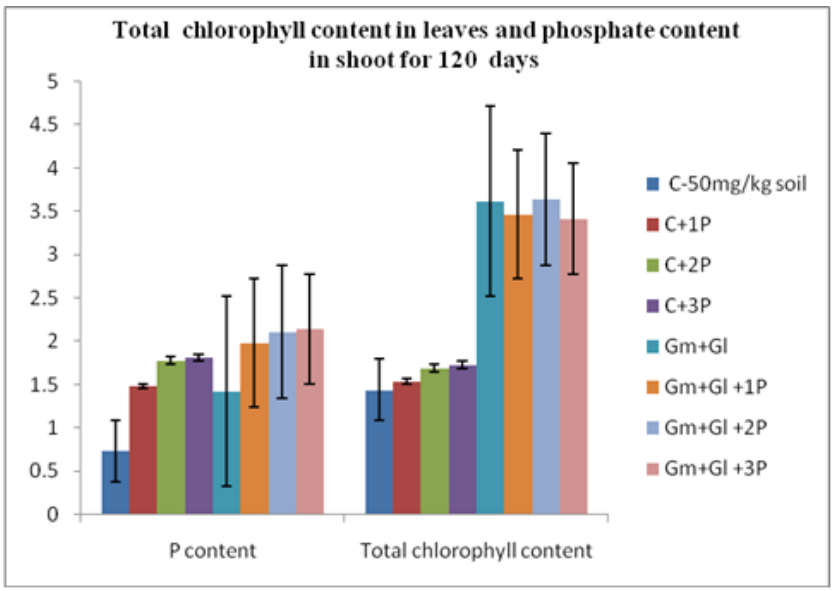


Fig 2: Effect of AM fungiand three phosphate level treatment on *Lagerstroemia lanceolata* with respect to Total chlorophyll and Phosphorous content for 120 days



Conclusion

The need for continued use of fertilizers in increasing the agricultural productivity to meet the growing demands of the people cannot be overemphasized. It is now becoming clear the ultimate "sink" of the fertilizers applied in agriculture and areas are soil. Soil being the storehouse of multitudes of microbes, in quantity and quality, receives the chemicals in various forms and acts as the scavenger of the harmful substances. The fertilizers reaching the soil in significant quantities alter the ecological balance. This may affect the overall microbial population, of which some of them may be selectively inhibited or killed. The fertilizers might alter the physiological conditions prevailing in the rhizosphere, which in turn alters the rhizosphere mycoflora both quantitatively and qualitatively. The chemicals used should avoid serious injuries to the great variety of microbes whose functions are vital to the crop-producing power of the soil. Finally, it can be said that higher concentrations of the fertilizers are not required in increasing plant growth as these result in greater degree of soil disturbance. The optimum benefit in terms of plant growth can be obtained from mycorrhizal symbiosis at a low fertilizer input. It is suggested that the low concentrations of the fertilizers must be applied which would have both an economic and environmental impact.

LITERATURE CITED

Abbott LK and Robson AD, 1984. The effect of root density, inoculue Placement, and infectivity of inoculum on the development of VA mycorrhizal fungi.N*ewPhytol*. **97**:285-299.

Chairmel T, Bagyaraj DJ, and Patil CSP, 2006. Response of *Andorgrophis paniculata* to different arbuscularmycorrhizal fungi. *Journal of Agricultural Technology,* **2**(2): 221-228.

DhandaSS, Sethi GS, and Behl RK, 2004. Indices of drought tolerance in wheat genotypes at early stages of plant growth. *Journal of Agronomy and Crop Science*, **190**(1):6-12.

Elahi FE, Mridha MA, U Aminuzzaman, 2010. Influence of AM fungal inoculation on growth, nutrient uptake, arsenic toxicity and chlorophyll content of eggplant grown in arsenic amended soil. *Advances in natural and applied sciences,* **4**(2): 184-192.

Ferreira, FS and Jarick J, 1995. Floral morphology of *Artemisia annua* with special reference to trichomes. *Inter. J plant Sci*, **156**:807-815.

Gerdemann JW and Nicolson TH, 1963. Spores of mycorrhizalEndogone species extracted from soil by wet sieving and decanting. *Trans. Brit. Mycol. Soc*, **46**: 235-244.

Gir B, Kapoor R. and Mukerji KG. 2003. Influence of arbuscularmycorrhizal fungi and salinity on growth, biomass, and mineral nutrition of *Acacia auriculiformis.Biology and Fertility of Soil*, 38:170-175.

Howeler RH, Siverding E, Saif S, 1897. Practical aspects of mycorrhizal technology in some tropical crops and pastures.*Plant and soil*, **100**:249-283.

Hosamani PA, Lakshman HC, Sandeepkumar K, Kadam MA, Kerur AS, 2011. Role of Arbuscular mycorrhizae in conservation of *Withania somnifera*, *Bioscience Discovery*, **02**(2):201-206.

Irfan A, YoobMandFite PK, 2011. Application of AM fungal inoculant on growth enhancement of *Solamum melangena L*. at different phosphorus level. *Mycorrhiza news*, **23** (3):9-12.

Jamaluddin, 2002. Bioinoulants for sustainable forestry. In :Bio inoculants for sustainable Agriculture and forestry. eds. S. M. Raddy, S. Rama Raddy. M.A Singarachary and S. Girisham Scientific publishers (India), Jodhpur, PP. 21-25.

Jackson ML, 1973. *Soil Chemical Analysis,* Prentice Hall, India (pvt)., New Delhi, PP 1-497.

Jeffries D, 1987. Use of mycorrhizae in agriculture. *Critical Reviews in Biotechnology*, **15**:319-358.

Kapoor R and Bhatnagar AK, 2007. Attenuation of cadmium toxicity in mycorrhizal celery (*Apiumgraveolens L*). *World Journal of Microbiology and Biotechnology,* **23:** 1083-1089.

Karthikeyan B Jaleel, CA changing, Z Joe, MM Srimannaragan, I and Deiveekasundarm M, 2008. The effect of AM fungi and phosphorus level on the biomass yield and ajmalicine production in C*artharathus rosea*. *EurAsian J Bioscience*, **2**: 26-33.

Katiyar RS, Das PK, Choudhury PC, Ghosh A, Singh GB, and Datta RK, 1995. Response of irrigated mulberry *Morusalba* L. to VA- mycorrhiza inoculation under graded doses of phosphorous plant. *Plant and soil*, **170**:331-337.

Kormanic PP and MC Graw AC, 1982. Methods and principles of mycorrhizal research. Ed. N.C.Schenck. *Am.Phytopath.Soc*, Pp 34-45.

Lakshman, HC. 2005, Response of *Albizzialebeck*D C. to AM fungi and Rhizobium interaction. *My forest*, **41**(2A): 295-300.

Lakshman, HC. 1996, VA - mycorrhizal studies in some important timber tree species. Ph.D thesis Karnataka University Dharwad - India 358pp.

Lakshman HC and Kolkar KP, 2008, Effect of AM fungus with additional P on the growth of *Hibiscus rosasinensis* L. *Nat. J.L. Sci,* **5**(2): 196-199.

Liu A, Hamel, C. Hamilton, RI Ma, B. Smith, DL 2000. Acquistion of Cu, Zn, Mn, and Fe by mycorrhizal maize (*Zea mays L*.)grown in soil at different P and micronutrient levels. *Mycorrhiza*, **9**:331-336.

Mosse B, 1973.Advances in the study of vesicular arbuscularmycorrhiza. *Ann Rev. Phytopathol*, **11**:171-196.

Pearson B and Tinker PB, 1975. Measurement of phosphorus fluxes in the external hyphae of Endomycorrhizae. In Endomycorrhizas.edited by F. E. Sanders, B. Mosseae, and P. B. Tinker, pp. 277-287. New York: Academic Press.

Phillips JM and Hayman DS, 1970. Improved procedures for cleaning and staining parasite and vesicular arbuscularmycorrhizal fungi for rapid assessment of infection.*Trans. Brit. Mycol. Soc,* **55(1)**:158-162.

Romana M Mirdhe and Lakshman HC, 2009. Seasonal variation in three Leguminous tree seedlings colonized with AM fungi. *Int. J. Plant. Sci*, **46**: 56-62.

Roopa KJ and Lakshman HC, 2009. Effect of AM fungus and additional phosphate on the growth of *Brassica junceae* L. *I. J. plant Sci*, **4**(1): 52-55.

Rubio R, Borie F. Schalchli C, Castillo C, Azcon R. 2003. Plant growth responses in natural acidic soil as affected by arbuscularmycorrhizal inoculation and phosphorus sources. *Journal of Plant Nutrition*, **25**: 1389-1405.

How to Cite this Article:

H C Lakshman and Kiran P Kolkar, 2014. Effect of additional phosphate on growth, biomass and P uptake in *Lagerstroemia lanceolata* Wall. Ex. C.B inoculated with AM fungi. *Sci. Res. Rept.,* **4**(1):57-63.