



**SUMMARY
AND
CONCLUSIONS**

5. General conclusion, overall trends, and practical implications

5.1. Inoculation experiment

Organic matter of leucaena cuttings, soybean straw, and rice straw inoculated with micro-organisms of *Asperagillus terreus* and *Azotobacter chroococum* proved efficient sources for N turn-over and mineralization especially leucaena which gave the highest mineralization. Rice straw gave lowest mineralization. In the inoculation experiment, the highest contents of mineralized N occurred after about 30 day following inoculation of the sand soil containing these organic material.

Inoculation was superior to no-inoculation between day 15, and day 45, when the Az and (As + Az) surpassed the non-inoculated, and was most effective with rice straw.

The superiority of Az over As in producing mineral N from the organic N was most prominent where rice straw was the source.

Leucaena was more efficient than a considerable superiority rice straw and soybean straw, due to its high N content, and apparently due to rapid decomposition and high C/N ratio. Superiority of soybean over rice straw was slight where Az was used as inoculants.

5.2. Greenhouse experiments (15N)

5.2.1. Lupine ¹⁵N experiment

I- Shoot dry weight was enhanced by compost and its mixture with leucaena. When organic sources were reinforced with ¹⁵N, the leucaena-compost mixture (LC_p) which gave the highest yield, and the other two were not significantly different from each other. Reinforcing the

organic N with mineral N caused an average greater N-uptake over the non reinforced treatment.

- II- Dry weight of roots was enhanced due to reinforcing organic N with mineral ^{15}N is thus of considerable positive effect in root growth. Leucaena or leucaena-compost mixture provided an efficient source of N than compost. Superiority of the leucaena-compost mixture was most prominent and considerable under conditions of N reinforcement. Nitrogen uptake by roots was increased according to the order of $\text{LC} > \text{L} > \text{C}$.
- III- Dry weight of root nodules was increased by applying nitrogen in all forms. Compost and LC gave more nodule weight than L alone. Reinforcing with ^{15}N caused an average of nodule dry weight greater over the non-reinforced treatments. Nitrogen uptake by lupine root-nodules reflected the highest N-uptake of lupine nodules was obtained by reinforcement in presence of compost C_p followed by LC_p and the least was in presence of leucaena L_p .
- IV- Available nitrogen remained in soil after lupine was higher with the mixture than compost or leucaena alone. This holds true with or without mineral nitrogen addition.

5.2.2. Barley ^{15}N experiment

- I- Shoot Dry weight indicated the superiority of leucaena forage over the compost or leucaena-compost mixture. Presence of mineral N enhanced the response to the organic sources. Reinforcing with mineral ^{15}N gave greater yield over the no-reinforcement. Nitrogen uptake by shoots has followed the order $\text{LC} > \text{L} > \text{C}$, and the superiority of LC was particularly true under ^{15}N reinforcement.
- II- Available nitrogen remained in soil after barley was significantly affected by adding mineral nitrogen (either

alone or in combination with the different organic sources).

5.2.3. Follow up of the fate of ^{15}N -experiments

5.2.3.1. Lupine experiment

- I- N derived from fertilizer (% Ndff) by lupine shoots was significantly affected by fertilizer addition either alone or reinforced with organic plant residues. Both, the portions (%) or absolute values (mg pot^{-1}) of Ndff were increased by adding the organic residues. Considerable amounts of nitrogen uptake by shoots are coming from soil pool.**
- II- The highest value of Ndffs was recorded with application of $\text{L} > \text{C} > \text{LC}$.**
- III- % Ndfa reflected an effective response of lupines plants to Rhizobium inoculation. Inoculation with this symbiont had compensate high percentage of N gained from air via biological nitrogen fixation process. Ndfa was significantly affected by organic residues. Addition of LC mixture reinforced with ^{15}N -fertilizer had enhanced the N_2 fixation and increased Ndfa value by about 66.7 % over those recorded with $^{15}\text{N}_0$ treatment. Lupine plant was more dependent on nitrogen derived from air which prove a good symbiotic relationship between the micro symbiont (Rhizobium) and the host plant (lupine). Therefore, its dependent on either fertilizer and / or soil nitrogen came to the next.**

5.2.3.2. Barley experiment

- I- The portions of nitrogen derived from fertilizer by barley plants was enhanced by addition of organic amendments. The highest portions or absolute values of Ndff was occurred with applying mixture of LC reinforced with ^{15}N mineral fertilizer.**

II- Barley plant was more dependent on fertilizer nitrogen than soil-N pool.

5.2.3.3. Recovery of ^{15}N in lupine and barley plants

I- The efficient use of fertilizer-N by either lupines or barley plants was significantly affected by incorporation of organic-N sources.

II- It seems that the ^{15}N recovery by lupines shoots was enhanced by adding organic sources.

III- The efficient use of fertilizer-N by barley plants was more pronounced than lupine plants. The highest recovery percent was induced by addition of LC mixture reinforced with ^{15}N , followed by C, then the L treatments.

IV- Comparison held between the two tested crops indicated that lupine was more dependent on biological- N_2 fixation (Ndfa) while barley plants were dependent on fertilizer-N.

5.3. Field Experiments

5.3.1. Lupine field experiment

I- Compost particularly at high rate of nitrogen was by far the most effective organic source compared with leucaena or leucaena-compost mixture when whole dry yield was considered.

II- Data of root dry matter yield indicated the superiority of compost and reflects a greater enhancement effect particularly at the high N rate. The nitrogen uptake by roots was positively affected by organic sources, although all sources of organic matter gave increases in N uptake, compost (particularly at high rate) was by far the most

effective organic source compared with leucaena–compost mixture or leucaena.

- III- Concerning the dry matter yield of shoots, compost was by far the most effective organic source compared with leucaena or leucaena–compost mixture. . Increasing the rate of addition gave either lower (as with L or LC) or no significant difference (as with C) with N_{24} as compared with N_{12} . By adding compost; the N uptake was increased by 371 % and 401 % due to N_{12} and N_{24} , respectively. Comparable values for leucaena were 359 % and 304 %, respectively.
- IV- Increasing the rate of nitrogen in case of C was associated with an increase in seed yield; increasing the N rate of L treatment was of negative effect. This negative effect may be due to a high immobilization decrease of the high rate of leucaena. Concerning the N uptake by seeds, the aforementioned pattern of response to organic sources show leucaena inferior to compost when the rate of N application was high and similar to it when the rate was low. Superiority of compost and its enhancement effect when the rate of application was high indicates enhanced mineralization.
- V- Available-N remained in the soil after lupine harvest showed that the remained nitrogen in soil after harvest was higher in case of 24 kg N ha^{-1} than those recorded with 12 kg N ha^{-1} , but slight differences were detected between the organic sources.

5.3.2. Barley field experiment

- I- Increasing leucaena was accompanied by decreased dry matter yield of whole plant while increasing compost was accompanied by an increase in dry matter yield. The mixture of leucaena–compost followed the same trend as that of leucaena.

- II- Weight of grains with spikes of barley reflected that the three sources of organic matter gave rather similar yields and compost was of a pronounced effect. N-uptake by grains with spikes indicated that increasing compost rate was more effective; the high rate was more efficient; whereas increasing leucaena rate was of less effect; the low rate was more efficient.**
- III- Straw yield of barley indicated that leucaena was by far the most effective organic source compared with leucaena–compost mixture or compost alone. N-uptake by straw showed that the increase of leucaena-compost mixture was more effective than other sources; the low rate was more efficient; whereas increasing leucaena rate was of less effect; the low rate was more efficient.**
- IV- Roots yield of barley was positively affected by compost which was by far the most effective organic source compared with leucaena–compost mixture or leucaena alone. N-uptake by roots indicated that although the 3 sources of organic matter were of nearly equal effect when applied alone, under conditions of presence of organic N to enhances their effect, leucaena–compost mixture (particularly at low rate) was by far the most effective organic source compared with compost or leucaena.**
- V- Available nitrogen remained in soil after harvest showed that, generally the available nitrogen remained in soil after harvest was significantly increased with increasing the rate of fertilizer – N added.**
- VI- The remained nitrogen in soil after barley was higher than those recorded after lupine.**

5.4 Practical implication

Organic amendment of leucaena could be an efficient source for N to sand soils. The rate of decomposition was rather high. Compared with other sources of organic-material-N, of compost or leucaena-compost mixture it proved a reliable source for N. Using leucaena in low to medium rates (up to 12 kg leucaena-N per hectare; i.e. 5 kg leucaena-N fed⁻¹) prove practical with no retarding effect. The retarding effect of high rates 24 kg leucaena-N ha⁻¹ could have been due to some polyphenolic substances in this organic material. For organic farming, leucaena may be a practical N-source.