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Effect of sowing density on number of tiller, ground cover and dry matter yield production of two green manure crops, winter rye (*Secale cereale* L.) and *lolium* mix

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ABSTRACT

Determining the effect of sowing density is crucial for good tillering and production of dry matter yield of green manure crops. An experiment was to determine the effect of sowing density on tiller number, total dry matter yield production and ground cover by green leaf blades of two green manure crops namely winter rye and lolium. Split-plot design was used with a green manure crop as a main factor and sowing density as a sub-plot factor with six blocks in 3 different sowing densities. An advisable sowing density of 50% and 100% did show a significant difference on the number of tillers for winter rye. Sowing density did show a significant linear effect on ground cover by green leaf blades of the crops. Sowing density showed a significant linear effect on total dry matter yield. To evaluate the effect of environment further investigation would be need.

Key words: Dry matter yield, Ground cover, Green manure, Lolium mix, Number of tillers, Sowing density, Winter rye.

INTRODUCTION

Incorporation of green manure crops in the soil improves the physical, chemical and biological characteristics of the soil. Abundance of soil microorganism increase with incorporation of cover crops in the soil, leads to rapid decomposition of fresh material in the soil (Cavigelli and Thien, 2003). The decomposed material allows the re-incorporation of nutrient like nitrogen, potassium, phosphorous, magnesium, calcium and sulphur in the soil. Green manure crops can also be used for suppression of weed growth. Increasing crop density improves crop competitive ability and hastens competition for limited resources (Brennan *et al*., 2009). This in turn reduces the population of insect damage and disease infestation harbored by weeds (Uchino *et al*., 2011). Winter rye (*Secale cereale* L.) and Italian rye (*Lolium multiflorium* L.) grass are most commonly used green manure crops that can withstand the low temperature in winter. Covering of the soil with green manure crops prevents soil erosion and reduces the amount of nitrogen loss through leaching (Hartwig and Ammon, 2002).The growth of green manure crops is influenced by light interception and different cultural practices such as sowing density and addition of nitrogen fertilizer. Therefore, determining effect sowing density is crucial for good tillering and dry matter yield production of green manure crops. Sowing density affect ground cover, dry matter yield and tiller production of two green manure crops (Cherr *et al*., 2006). At highest density it would be expected that crop produces more tillers and more dry matter yield. More tillers would be expected to produce more ground cover crop and total dry matter yield. The tillering capacity of winter rye is better than that of *Lolium* mix. As increasing the number of tiller per specific area there would be high ground cover, this in turn results in more total dry matter yield. Crops with high tillering capacity requires less sowing density.Therefore, this research was conducted with the objectives of determining the effect of sowing density on tiller number, total dry matter yield production and ground cover by green leaf blades of two green manure crops and identifying which of these two green manure crops is highly affected by sowing density.

MATERIALS AND METHODS

The experiment was conducted on two green manure crops Italian ryegrass (*Lolium multiflorium* L) (50%) Westerwold(50%) rye grass (*Lolium multiflorium* L. spp. *alternativum*) and winter ryegrass (*Secalecereale* L.) on sandy soil at De born,Wageningen, the Netherlands. The experimental site is located at 51° 57' 57'' N, 5° 38' 37'' E. The crops were sown on September 13, 2012 and harvested on February 11, 2013. The experiment was carried out on split plot design with a green manure crop as a main factor and sowing density as a sub-plot factor with six blocks. Three sowing densities of 50%, 100% and 200% of the advice rate

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of 7.5kg ha^{-1} for *Lolium*mix , 75kg ha^{-1} for Winter rye, 15kg ha^{-1} for *Lolium* mix, 150 kg ha^{-1} for Winter rye and 30kg ha^{-1} for *Lolium* mix, 300 kg ha^{-1} for Winter rye respectively were used. The thousand seed weight of winter rye and *Lolium mix* was determined. The experiment was conducted with a total area of 203m x 228m.

The seeds were sown at a depth of 2-3 cm and 300 kg ha^{-1} of nitrogen: phosphorous: Potassium (NPK) with a ratio of 12:10:18 respectively was added during the growing period. Crop protection practices like weeding and insect and disease control were not done.

The average temperature during the growing period at 10cm above the ground was 6.5°c and 6.7°c at 5cm soil depth and short wave radiation incoming during the growing period was 53.8 W m^{-2}. The total precipitation of the growing period was 347.4mm and the average relative humidity was 84%http://www.met.wau.nl/haarwegdata.

Field observation was carried out to determine the ground cover percentage of the two green manure crops. The above ground fresh matter of the 4 inner rows was harvested by hand. The soil adhered to the above ground part of the green manure crops and weeds were removed. The samples were put in a labeled plastic bag and transferred to the laboratories for further analysis. After weighing the total fresh weight of the two samples; subsamples of the two crops were taken, one for determining the dry matter concentration and the other for crop subsample separated into three fractions *Vis*, leaf sheath, dead part and green leaf part. Number of tillers were counted for crop subsamples and part of the leaf fraction subsamples was again sampled for leaf area measurement. The fresh weights of the three subsamples were again weighed and all subsamples were subjected to drying at 105^{0}c for 16hrs in oven to determine dry matter concentration of crop fractions. Number of tillers per m^2 area, ground cover by green leaf blades of crops in percent (%) and total dry matter yield in g/m^2were calculated and analyzed for data presentation.

Ground cover of green leaf blades of crops (%) = average of individual observation

Number of tillers per m^2 =

[Total fresh weight (g/m^2) × Number of tillers per shoot] /Sample fresh weight g/m^2

Total dry matter yield g/m^2 =

[Total fresh weight g/m^2 × dry matter concentration in the fresh mass (%)] /100

Statistical analysis: The data were analyzed by using statistical software Genstat 15th edition. For the analysis of variance Split-plot design was used with Crop as main factor and Sowing density as sub factor and their effect separated by linear and quadratic components. We used the criterion for declaring significant is $P< 0.05$ for their interaction effect. The mean significance of the treatments were separated by Fisher protected *LSD*-test (5%).

RESULTS AND DISCUSSION

There was a linear interaction between sowing density and green manure crops on the number of tillers per meter squared (m^{-2}) area (Fig.1). The number of tillers m^{-2} area was highly significant ($P = 0.009$) for two green manure crops and sowing density. For *Lolium* mix the number of tillers showed a significant linear increase with sowing density. The number of tillers m^{-2} was increased at highest density of sowing for both crops. Interaction effect was weak on number of tillers m^{-2} (Fig.1).

Sowing density significantly affects ground cover of green leaf blades of crops ($P< 0.001$) and the difference was linear for both winter rye and *Lolium mix*. For winter rye the ground cover by green leaf blades was more than *Lolium* mix (Fig.2).

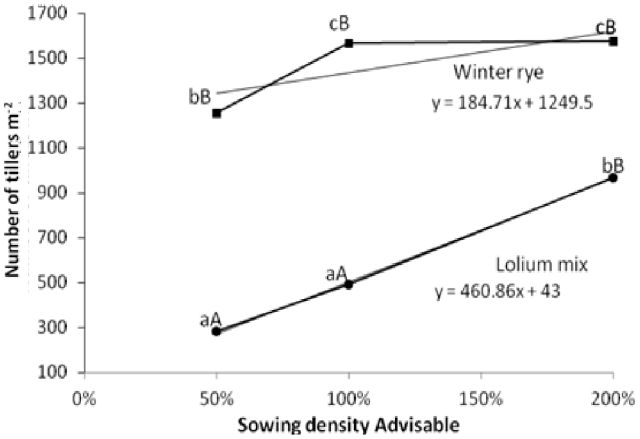

Fig 1: Effect of sowing density on the number of tillers m^{-2} of the two green manure crops. Points followed by different letters differ significantly ($P<0.05$) according to the LSD-test = 297.2 for differences between crop and sowing density and 277.5 for means within a crop. Lower case letters indicate differences between crops and sowing density and upper case letters indicate differences within crops.

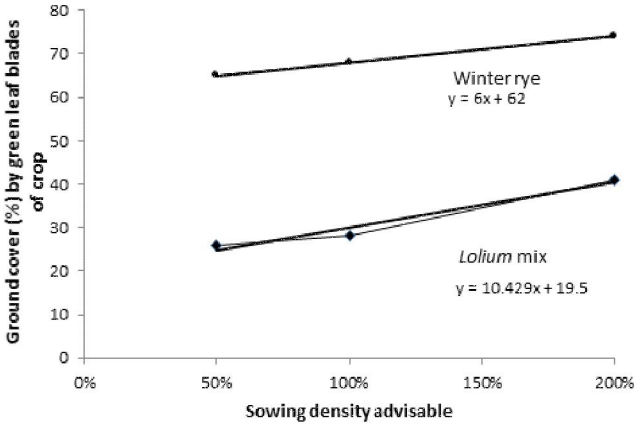

Fig 2: Effects of sowing density on ground cover by green leaf blades crops. Sowing density did show a significant linear effect on ground cover by green leaf blades of the crops ($p < 0.05$). According to the (LSD-test = 9).

There was no significant interaction between sowing density and the two green manure crops on total dry matter yield (Fig.3). To *Lolium mix* total dry matter yields increased significantly with increasing sowing density. For winter rye there was a slight increase in total dry matter yield at 50% and 100%, advisable sowing densities while the total dry matter yield after 100% advisable sowing density remains the same.

Number of tillers m^{-2} for *Lolium* mix was increased with increasing sowing density but increasing sowing density did not show a significant difference (*LSD0.05* = 297.2) increment on the number of tillers in winter rye (Fig.1). The increase in the number of tillers per unit area results in increasing the ground cover percentage of green leaf blades of crops. This might contribute for suppression of weeds and reduction of soil erosion. According to (Uchino *et al*., 2011) increasing ground cover percentage contributes in suppression of weeds and reduces soil erosion. The result in 2012 revealed that the number of tillers increased with increasing sowing density in *the Lolium mix* (result not shown). Winter rye did not show the same response to sowing density rather it remains constant after a certain advisable density of sowing. Interaction between sowing density and two green manure crops did not show a significant effect on the total dry matter yield ($P = 0.096$). Thus, high total dry matter production might not be the same in different sowing densities. Sowing density did show a significant linear effect on ground cover by green leaf blades of the crops ($P < 0.001$). Winter rye and *Lolium mix* did show a significant effect on the ground cover by leaf blades of crops ($P < 0.001$) while the ground cover performance for winter rye was better than *Lolium* mix (*LSD*0.05 = 9.0). The total dry matter yield of *Lolium* mix increased linearly with increasing sowing density and the total dry matter yield obtained at advisable sowing density 200% was about 27.8 gm^{-2} (Fig.3). Whereas, the total dry matter yield obtained in 2012 was 143.3 GM^{-2} (result not shown) for *Lolium mix* which is by far greater than the total dry matter yield obtained in 2013. Sowing density did show a significant linear effect on total dry matter yield ($P < 0.001$). It was obtained that at a low sowing density (50%) the total dry matter yield was low as compared to the two sowing densities (Fig.3). This lower sowing density resulted in low ground cover and produces less tiller number m^{-2}.This result is in agreement with (Kramberger *et al*., 2007) that explained higher sowing density of Italian rye grass 30 kg ha^{-1} resulted in higher production of dry matter yield and decreases percentage of weeds.

Sowing density did not show significant difference on total dry matter yield of winter rye. Therefore, it is advisable to use low sowing density 50% of advisable sowing density in order to economize the amount of seed required for sowing since cost of seed is too expensive. For *Lolium mix* the optimum sowing density is still not determined. But

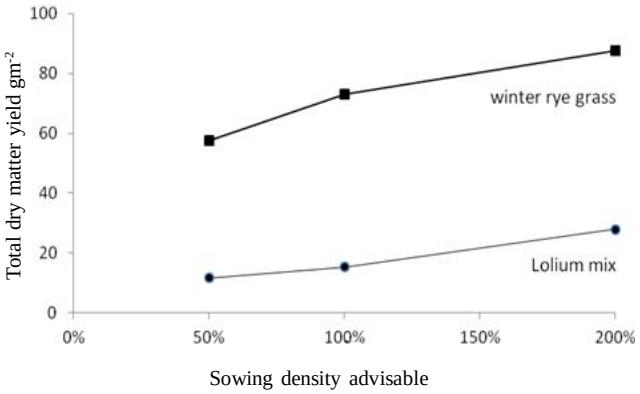

Fig 3: Effect of sowing density on the total dry matter yield of two green manure crops. There was no significant interaction between sowing density and the two green manure crops on total dry matter yield(P = 0.096)2013result

optimum sowing density of 200% was better performed in this research as increasing sowing density the total dry matter was increased linearly. Therefore, further investigation is needed to determine the optimum density of sowing. But optimum advisable sowing density of 200% could be used as standard for further study to determine the sowing density of *Lolium mix*.

For practical implication on this experiment we can conclude that the number of tillers m^{-2} significantly ($P < 0.009$) increased with sowing density. This in turn resulted in a good ground cover and has good implication in improving soil organic matter content, suppresses weed and minimizes the amount of nutrient leaching. The experiment was conducted in specific area, thereforefurther investigation would be needed to see the influence of sowing density on total dry matter yield, tiller number and ground cover of the two green manure crops to evaluate the effect of environmental conditions.

CONCLUSION

An advisable sowing density of 50% and 100% did not show significant difference on the number of tillers m^{-2} for *Lolium mix* while 200%, advisable sowing density did show a significant difference on the number of tillers for *Lolium mix*. Sowing density did show a significant linear effect on ground cover by green leaf blades of the crops. Winter rye and *Lolium mix* did show a significant effect on the ground cover by leaf blades of crops while the ground cover performance for winter rye was better than *Lolium mix*. The total dry matter yield in general did not show a significant interaction between the two green manure crops and sowing density. Sowing density did show a significant linear effect on total dry matter yield. It was obtained that at a low sowing density of 50% the total dry matter yield was low as compared to the two sowing densities of 100% and 200%.

REFERENCES

Brennan E.B., Boyd N.S., Smith R.F. and Foster P. (2009). Seeding rate and planting arrangement effects on growth and weed suppression of a legume-oat cover crop for organic vegetable systems, *Agronomy Journal* **101:**979-988.

Cavigelli M.A. and Thien S.J. (2003). Phosphorus bioavailability following incorporation of green manure crops. *Soil Science Society of America Journal* **67:**1186-1194.

Cherr C., Scholberg J. and McSorley R. (2006). Green manure approaches to crop production. *Agronomy journal* **98:** 302-319.

Hartwig N.L. and Ammon H.U. (2002). Cover crops and living mulches. *Weed Science* **50:**688-699. http://www.met.wau.nl/haarwegdata.

Kramberger B., Gselman A., Kapun S. and Kaligaric M. (2007). Effect of sowing rate of Italian Ryegrass drilled into pea stubble on removal of soil mineral nitrogen and autumn nitrogen accumulation by herbage yield. *Polish Journal of Environmental Studies* 16.

Uchino H., K Iwama K., Y Jisuyama Y., K Ichiyama K., Eri Sugihara E. and Yudate T. (2011). Stable characteristics of cover crops for weed suppression in organic farming systems. *Plant Production Science* **14:**75-85.