The Effect of Soil Organic Matter and Soil Moisture Control on Early Stage of Sunflower's Root Growth

○Bernardikus Patrick Daundy*, D. Ogawa*, H. Inoue**, T. Sato***

1. Introduction

In rotational paddy field there is a problem such low porosity of soil, which can lead to wet injury problem. This wet injury problem can effects sunflower's growth. These effects emergence of seed and elongation of root. This problem occurs because in generally paddy field soil is single grained-structure. The respond of this problem is soil improvement, which require such as application of soil organic matter to improve quality of porosity. Furthermore, soil moisture control also necessary to provide adequate water for plant root. The objective of this experiment is to determine the effect of soil organic matter and soil moisture control on early stage of sunflower's root growth.

2. Material and Method

Sunflower seedling was planted in 1960cm³ pots. Pot was composed of decomposed granite soil and different amount organic matter 0t/ha (non soil organic matter), 3t/ha, 6t/ha, 12t/ha (standard amount of organic matter) (Table. 1). Soil and organic matter were dried before sieved through 2mm sieve. Organic matter was used is barnyard manure, which has low content of chemical nutrition. Sunflower was watered by distilled water. Plant was watered around 18:00, until the end of cultivation period.

This study was conducted under condition of growth chamber, where temperature can be controlled. Period of cultivation were 15, 20, and 30 days. Sunflower was cultivated in three different soil moisture 0.12cm³/cm³ (dry soil), 0.14 cm³/cm³ (adequate moist soil), 0.19cm³/cm³ (moist soil). (Table.1). Seedling was held in soil moisture 0.24 cm³/ cm³.

Root growth was measured by separate it from plant and used scion software to calculate the length, which could lead to root distribution density. Evapotranspiration was determined every day by measured pot weight, before and after watered the sunflower. Evaporation was measured in pot without seedling.

3. Result and Discussion

(1) Effect of Differences Soil Organic Matter and Soil Moisture Control on Root Distribution Density

Root distribution density increased, while amount of organic matter increased (Fig. 1). No application of soil organic matter condition had lowest root distribution density. In high soil moisture condition, root distribution density increased. These caused by organic matter exist among particle of soil, which can reduce resistance on root. In high soil moisture, the soil hardness was decreased (Table. 1), which caused increasing of root penetration. This condition also can provide adequate water to absorbed, which support sunflower's root growth.

Table. 1 Soil condition

SOM (t/ha)	Soil moisture (cm³/cm³)	Solid (vol%)	Water (vol%)	Air (vol%)	Soil hardness in 30 day (mm)	Soil Moisture on soil hardness measurment (cm³/cm³)
0	0.19	54.3	19.0	26.7	16.1	0.17
	0.14	54.3	14.0	31.7	21.1	0.12
	0.12	54.3	11.5	34.2	21.3	0.10
3	0.19	54.3	19.0	26.7	11.1	0.15
	0.14	54.3	14.0	31.7	18.5	0.10
	0.12	54.3	11.5	34.2	19.3	0.08
6	0.19	54.4	19.0	26.6	13.0	0.15
	0.14	54.4	14.0	31.6	17.1	0.10
	0.12	54.4	11.5	34.1	21.0	0.09
12	0.19	54.5	19.0	26.5	18.2	0.14
	0.14	54.5	14.0	31.5	22.0	0.09
	0.12	54.5	11.5	34.0	21.4	0.08

*Graduated School of Agriculture, Kochi University, **NARO/WARC, ***Faculty of Agriculture, Kochi University

Keyword : Multi-purpose farm land, Soil improvement, Soil organic matter, Farm land conservation

Eavis (1971) confirmed that there are ranges of soil moisture which can support root growth.

(2) Effect of Differences Soil Organic Matter and Soil Moisture Control on Evapotranspiration

In the increasing of organic matter amount and soil moisture, resulted evapotranspiration of sunflower in 15-20 days was increased (Fig. 2). Increasing of evapotranspiration can be indicated as the improving of sunflower's growth in sufficient amount of organic matter and soil moisture condition. The increasing of evapotranspiration considered as increasing of transpiration from leaf and evaporation from soil surface.

(3) Effect of Differences Soil Organic Matter and Soil Moisture Control on Water Uptake by Root

Increasing of organic matter and soil moisture effected the change of water uptake by root (Fig. 3). However, in soil moisture 0.14cm³/cm³ and 0.12cm³/cm³ shown insignificant change. Increasing of water uptake indicated that root growing well. Thus, in highest amount of soil organic matter caused decreasing of water uptake by root and soil condition at 6t/ha and 0.14cm³/cm³ had insignificant change of water uptake compared with soil in 12t/ha and 0.14cm³/cm³. This situation occurred because water stress is required to increase water uptake. However, in limited amount of pot soil, root density was higher than root density in sunflower farm field in generally. In farm field of sunflower root distribution density approximately about 1cm/cm³.

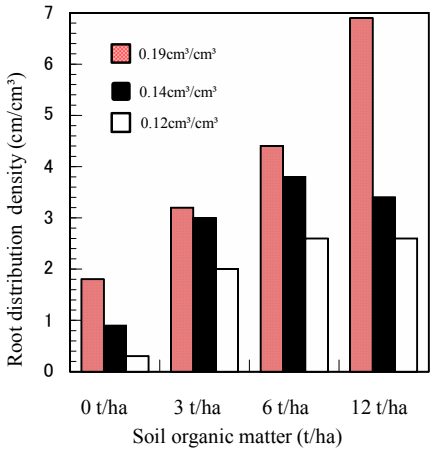

Fig. 1 Relation between root distribution density and soil organic matter

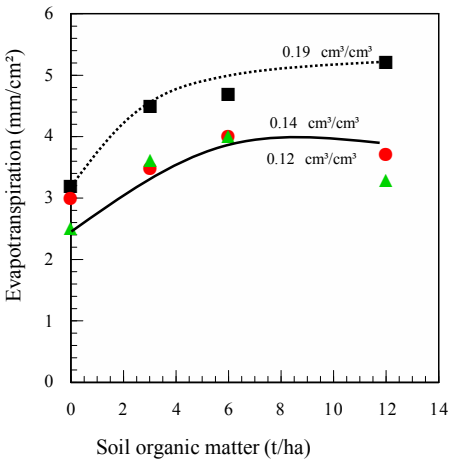

Fig. 2 Relation between soil organic matter and evapotranspiration in 15 – 20 days of cultivation

(4) Conclusion

Early stage of sunflower's root growth within organic matter was better than only soil cultivation. In moist soil condition, growth of sunflower was improved. In amount of soil organic matter 3t/ha, 6t/ha and 12t/ha, water uptake by root became nearly constant, which means in soil organic matter can be apply less than standard amount. This study suggests that soil organic matter and moisture at 6 t/ha and 0.14cm³/cm³ is adequate for root to uptake soil water optimally. The increasing of evapotranspiration of sunflower can be used as one alternative solve the wet injury problem.

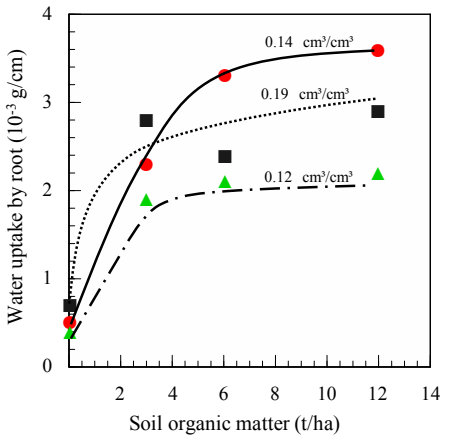

Fig. 3 Relation between soil organic matter and water uptake by root in 20 days on cultivation

Reference

Eavis, B. W. (1971), Plant and Soil. 36, 613 – 622.