Production and Nutrient Uptake Improvement of Sweet Corn by Organic - Inorganic Fertilizers and AMF Inoculation

Dwi Retno Lukiwati
Diponegoro University
INDONESIA

Mycorrhiza Fungi

FMY ‘plus’
INTRODUCTION

Land use dynamics

Native savanna

Extensive cattle ranching

Crop-livestock systems

Legume-fix. N₂
Crop - Livestock System

- Sweet corn → food
- Stalk → feed
- Farmyard manure → soil fertility
Tropics: after World War II

Inorganic fertilizer application widely used to improve soil fertility

Application of inorganic fertilizer has been used since 1960’s in Indonesia
Latosolic soil

Low soil pH (acid soil)
< N → urea, ZA (ammonium sulphate)
< P → superphosphate → phosphate rock

SP → expensive
PR → cheap, slow release
Solution → PR + ZA (acidulation)
PR + AMF (microb. activity)
Phosphate Rock in Indonesia

Production (1988) = 1,000 ton
(Stowasser 1990 in Van Kauwenbergh, 2001)

Total $\text{P}_2\text{O}_5$ consumption = 360,000 ton
Phosphate rock consumption = 69,000 ton
(used on plantation crops) (Adiningsih et al., 1998)

PR 27 % $\text{P}_2\text{O}_5$
SP 36 % and 18 % $\text{P}_2\text{O}_5$
INORGANIC vs ORGANIC

Inorganic $\rightarrow$ high nutrient, expensive

Organic $\rightarrow$ low nutrient, bulky
  a. Farmyard manure
  b. FMY + PR $\rightarrow$ FYM plus

Inorganic + organic + AMF $\rightarrow$ ?
SOIL – CROP – AMF – FERTILIZER

ORGANIC INORGANIC fertilizer

PLANT

AMF
FUNCTION OF ARBUSCULAR MYCORRHIZA FUNGI

NUTRIENT UPTAKE

DRY SEASON

PATHOGEN

HORMON

SYNERGY FIX. N₂ SIMBIOTIK

SYNERGY FIX. N₂ NON-SIMBIOTIK

SYNERGY

Acetobacter - Saccharomyces

“METAL BINDING AGENT”

“AGGREGATES SOIL PARTICLES BINDING AGENT”

PGR

SYNERGY FIX. N₂
Mycorrhiza + Phosphate Rock

Arbuscular mycorrhiza + PR

P uptake = SP

External hyphae

- plant available P-in soil
- high-affinity P uptake (mechanism)

increased

through

scavenging for

(Hayman, 1983; Simanungkalit & Lukiwati, 2001)
Appresorium

Arbuscle

Internal hyphae

External hyphae

Vesicle
Without AMF inoculation

→

AMF Root colonization

→
Family of *Glomaceae*
Family of *Acaulosporaceae*
Family of *Gigasporaceae*
Sweet Corn Production and Nutrient Uptake with AMF Combined with Organic (farmyard manure) and Inorganic (phosphorus, nitrogen) Fertilization
MATERIALS AND METHODS

- Field experiment → 70 days
- Latosolic soil: pH → 5.15 - 5.11 - 5.30
  available P → 1.18 - 1.48 – 2.17 ppm
  N → 0.132 – 0.142 - 0.164 %
- CRBD – 3 block replicates
- Data analyzed – GLM of SAS and DMRT
Inorganic: P (SP-18 P$_2$O$_5$ %, PR-27% P$_2$O$_5$ %)

N (urea - 45% N, ZA - 21% N)

Organic: farmyard manure (FYM)

farmyard manure plus (FYM plus)

Arbuscular mycorrhiza fungi: no inoculated

Standard fertilization: KCl – 50 % K$_2$O

Sweet corn (Zea mays saccharata)
### Table 1. Sweet Corn and Stalk Dry Matter Yield

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Sweet corn (kg/m²)</th>
<th>DM Yield (g/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FYM + PR + ZA</td>
<td>1.18 b</td>
<td>162.12 c</td>
</tr>
<tr>
<td>FYM + SP + urea</td>
<td>1.22 b</td>
<td>227.61 bc</td>
</tr>
<tr>
<td>FYM + PR + ZA + AMF</td>
<td>1.31 b</td>
<td>246.06 abc</td>
</tr>
<tr>
<td>FYM + SP + urea + AMF</td>
<td>1.25 b</td>
<td>244.06 abc</td>
</tr>
<tr>
<td>FYM plus + PR + ZA</td>
<td>1.31 b</td>
<td>263.15 ab</td>
</tr>
<tr>
<td>FYM plus + SP + urea</td>
<td>1.32 b</td>
<td>319.13 a</td>
</tr>
<tr>
<td>FYM plus + PR + ZA + AMF</td>
<td>1.53 ab</td>
<td>296.23 ab</td>
</tr>
<tr>
<td>FYM plus + SP + urea + AMF</td>
<td>1.71 a</td>
<td>290.13 ab</td>
</tr>
<tr>
<td>Treatments</td>
<td>N uptake g/m²</td>
<td>P uptake g/m²</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>---------------</td>
<td>---------------</td>
</tr>
<tr>
<td>FYM + RP + ZA</td>
<td>2.39 c</td>
<td>1.14 b</td>
</tr>
<tr>
<td>FYM + SP + urea</td>
<td>3.56 bc</td>
<td>1.23 b</td>
</tr>
<tr>
<td>FYM + RP + ZA + AMF</td>
<td>4.27 ab</td>
<td>1.26 b</td>
</tr>
<tr>
<td>FYM + SP + urea + AMF</td>
<td>4.03 ab</td>
<td>1.71 ab</td>
</tr>
<tr>
<td>FYM plus + RP + ZA</td>
<td>4.70 ab</td>
<td>1.81 ab</td>
</tr>
<tr>
<td>FYM plus + SP + urea</td>
<td>5.24 a</td>
<td>1.32 b</td>
</tr>
<tr>
<td>FYM plus + RP + ZA + AMF</td>
<td>5.24 a</td>
<td>1.87 ab</td>
</tr>
<tr>
<td>FYM plus + SP + urea + AMF</td>
<td>4.50 ab</td>
<td>1.41 b</td>
</tr>
</tbody>
</table>
CONCLUSION

Sweet corn production and nutrient uptake with organic+inorganic+AMF tends to be higher than without AMF.

Dry matter production, N uptake with FYM ‘plus’ + NP was higher compared to FYM + NP.

Therefore, FYM fertilizer could increase sweet corn production and nutrient uptake if combined with phosphate rock (= FYM ‘plus’).
ACKNOWLEDGEMENT

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