Indian Journal of Agricultural Research

Effect of Inorganic Fertilizers and Stingless Bee Pollination on Increasing Productivity of Corn (*Zea mays* L.)

Dewirman Prima Putra, Murnita , Jasmi

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Name and Address of corresponding author	: Dewirman Prima Putra, Department of Agrotechnology, Faculty of Agriculture, Universitas Ekasakti, Padang 25112
Contact #	: dewirman007@gmail.com
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Effect of Inorganic Fertilizers ~~Optimization of~~ and Stingless Bee Pollination ~~in~~ on Increasing ~~the~~ ~~Products~~ Productivity of Corn (~~*zea*~~ *Zea mays* ~~L.~~L.)

Authors (Missing?)

Department of Agrotechnology, Faculty of Agriculture, Universitas Ekasakti, Padang 25112.

Department of Biology, Sekolah Tinggi Kejuruan dan Ilmu Pendidikan PGRI West Sumatra, Padang 25137

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ABSTRACT

This study was ~~aims~~ aimed ~~to get the~~ at ~~optimization of the~~ increased production of corn by ~~using~~ optimized dose of inorganic fertilizers and pollination with the help of stingless bees ~~without the sting~~. The study was carried out ~~in~~at Korong Gadang sub-district, Kuranji District, Padang City ~~(0 ^{0} 57 'LS, 100 ^{0} 21' BT)~~ at an altitude of~~with a height of~~ 20 m above sea level ~~(dpl.)~~. The experiment ~~used a randomized block design with~~comprised of 4 treatments ~~and 3 replications~~laid out in randomized block design replicated thrice. The results of the study ~~shows~~ showed positive influence of ~~the contribution amount~~doses of inorganic fertilizer and stingless bee pollination ~~to the increase in~~on corn production. ~~The experiment used a randomized block design with 4 treatments and 3 replications. The study was carried out in Korong Gadang sub-district, Kuranji District, Padang City (0 ^{0} 57 'LS, 100 ^{0} 21' BT) with a height of 20 m above sea level (dpl.).~~ There was ~~results showed~~ an increase in ~~corn products per fruit~~number of seeds per cob and cobs ~~and~~ per plot ~~is more dominated by the~~due to fertilization ~~paradigm~~ than the pollination ~~paradigm~~stingless bees. Increased seed production per plot ~~for~~ due to fertilizer use ~~an organic range~~ranged between 17.25 to 25.06% compared to organic ~~fertilizer~~manures. ~~Nevertheless, the~~ The pollination process ~~can~~ could increase the production ~~per plot~~in the range of 3,98 - 6.66% compared to wind pollination. Thus Pollination with *Trigona laeviceps* ~~can~~ ccould help seed ~~weight and product~~yield per ha, ~~but must be~~when accompanied by the ~~use~~ application of inorganic fertilizers. The use of organic ~~fertilizer~~ manures ~~has not been able to~~could not meet the ~~nutrients~~ nutrient requirement of the crop ~~so that the production quantity is still~~ and hence production was low.

Keywords: Optimization, Fertilization, Pollination, Production, Stingless bee

INTRODUCTION

Currently, farmers just assume that fertilizer is the only ~~activity~~ input that contributes to improving agricultural output. ~~,~~ ~~even~~ Further they believe ~~the~~ that bigger the fertilizer dose they provide ~~then will the~~ higher the production they would earn. They do not know ~~that~~ the

role of ~~animals~~ bees that help the pollination process (pollinators) ~~can~~ could increase their ~~agricultural output~~crop yield. They often ~~worst condition is that they~~ think the pollinator is a pest ~~for~~ of the plants.

Pollination ~~or pollination~~ is a ~~method of sexual reproduction of plants which is a~~ mechanism of transfer of pollen from anther in male flowers to female flower stigma (Evans and Spivak, 2006; Higo~~, Rice, Winston and Lewis,~~ *et al.*, 2004). Pollination by pollinators is an important ecosystem service ~~because~~ as 35% of global food supply comes from plants that depend on animal pollination (Klein *et al.*, 2007) and 70% of all fruit and vegetable crops show an increase in the size, quantity, quality, or stability of the harvest when pollinated by bees or other animals (Ricketts *et al.* 2008; Nicholls and Altieri 20-12).

Some researchers ~~results~~ have shown that an increase in both the quality and quantity of agricultural products due to pollinators. In Kakamega, Kenya, there ~~is~~ was an increase in ~~results~~ yield ranging between 25% - 99% of various plants with the help of bees as pollinating insects (*pollinators)* (Kasina, 2007). The results of research on

chili plants~~,~~ showed an increase in fruit ~~weight~~ yield per plant by 49.75% -66.46% and production per ha by 40.83% -54.26% pollinated by *Trigona* sp (Putra, *et al.*, 2016). In sunflower (*Helianthus annuus)* an increase in seed ~~production~~ yield of 78.37 % was observed, when compared with plants without access to pollination ~~made~~ by insects (Paiva, 2000).

Corn is a monoecious plant ~~because~~ with male and female flowers ~~are found~~observed in ~~one~~ the same plant. Corn plants are protandry, wherein most varieties, male flowers appear (anthesis*)* 1-3 days before female flower hair appears (silking) (Malerbo-Souza *et al.*, ~~(~~2008). ~~Therefore, the~~ Corn crop is ~~called~~ mostly cross-pollinated ~~crops~~, where most of the pollen comes from other plants. ~~Corn plants that only have pollen and do not have nectar, then the arrival of insects only on male flowers~~. Cross-~~pollinated~~ pollination always require ~~agent~~ pollinators that carry pollen from one flower to ~~anthera~~ stigma of another flower.

~~From~~ On the basis of ~~the two paradigms of increasing agricultural products described~~ the above observations, ~~it is necessary to~~an experiment was conducted ~~research on~~ to study the effect of ~~Inorganic~~ inorganic ~~Fertilizers~~ fertilizers ~~Optimization and~~in combination with ~~Stingless~~ stingless ~~Bee~~ bee ~~Pollination~~ pollination in ~~Increasing~~ increasing ~~Corn~~ corn ~~Crop~~ yield (*Zea mays* L.) ~~This study aims to evaluate whether the fertilizing paradigm makes a beneficial contribution optimal or the pollination paradigm in corn plants.~~

MATERIALS AND METHODS

This ~~research has been~~experiment was carried out ~~in~~ at Korong Gadang Sub-District, Kuranji District, Padang City ~~(0 ^{0} 57 'LS, 100 ^{0} 21' BT)~~ which is ~~included in the~~considered to

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be lowlands. ~~(20 m dpl).~~ The experiment consisted of 4 treatments viz. P_O (Fertilizers inorganic and pollination by wind, P_1 (Organic fertilizers and pollination by *Trigona laeviceps*, P_2 (Inorganic fertilizers and pollination by *Trigona laeviceps*, P_3 (inorganic fertilizers and pollination by other pollinators laid out in randomized block design (RBD) replicated thrice. The sowing was done on

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~~Research Implementation~~

~~Plant maintenance begins with a~~ raised bed of length 350 cm, width 50 cm and a height of 20 cm with ~~the distance between beds 50 cm. Each treatment consisted of four plots, with~~ at a spacing of 75 x 25 cm on a bed size of ~~and one hole for one plant. The beds are locked in a waring where the confinement is made in the size of~~ 4m x 4m ~~x 3m~~. Single ~~doses~~ dose of ~~N, P, and K fertilizer used were~~ 350 kg urea, 175 kg ~~SP 36~~single super phosphate, and 100 kg ~~KCl~~ potassium chloride / ha was applied at the time of sowing.

~~Experimental design and data analysis~~

~~The experimental design used in this study is a Randomized Block Design (RAK), with 4 treatments and 3 replications where treatment~~: ~~P_O (Fertilizers inorganic and pollination by wind, P_1 (Organic fertilizers and pollination by *Trigona laeviceps*, P_2 (Inorganic fertilizers and pollination by *Trigona laeviceps*, P_3 (inorganic fertilizers and pollination by other pollinators.~~ Observations were recorded on ~~parameters consisted of~~ cob length, ~~ear~~ cob diameter, number of co~~m~~bs, weight ~~per~~ of ~~ear~~cob, ~~the~~ weight of 100 seeds, and ~~production~~ seed yield per plot.

The data ~~obtained~~ recorded were analyzed using analysis of variance (ANOVA) techninque and ~~if~~ when $F_{hit} > F_{tab}$ 5%, then ~~continued~~ Duncan ~~New~~ Multiple Range Test (D~~N~~MRT) ~~tests~~was carried out to to check the statistical superiority of the treatments. Data analysis was performed using SPSS 16 statistical software.

RESULTS AND DISCUSSION

Cob length, ~~Con~~ Cob diameter~~,~~ and ~~amount~~ number of co~~m~~bs

The average length of cob, cob diameter and ~~a lot~~number of ~~corn~~ co~~m~~bs with various fertilizing and pollination treatments are presented in Table 1. The results showed that the length of the cob and ~~the many~~number of co~~m~~bs per plot recorded with ~~of the~~ P_1 treatment were significantly ~~different~~ lower as compared to ~~from the treatments of~~ P_0, P_2, and P_3, ~~and~~ P_0, ~~treatment~~, P_2, and P_3 did not differ ~~markedly~~ significantly with ~~not~~ each other. ~~Treatment c~~Cob diameter in P_0 ~~no~~ was ~~significant effect~~at par with ~~treatment~~ P_2 and P_3, but was significantly different as compared to P_1, ~~treatments.~~ P_1 and P_2 were at par with each other. ~~treatment is similar to the treatment of P_2.~~

~~Significantly~~ Significant ~~different~~ differences in cob length, ~~ear~~ cob diameter and number of co~~m~~bs per plot were observed in treatment P_1 ~~with treatments~~ as compared to P_0, P_2, and P_3~~,~~ ~~,~~ ~~this~~ This ~~is~~ may be due to ~~the treatment P_1~~ the fact that ~~fertilizer used is~~ organic fertilizer used in that treatment, whereas in other treatments ~~the fertilizer used is~~ inorganic fertilizer was used. Although ~~N~~nutrient content of organic fertilizer~~, although complete~~ comprises both macro and micro elements, the percentage is very low. Hartatik and Widowati (2010), reported that ~~nutrient~~ the content of N, P and K~~,~~ in cow manure was , ~~respectively~~ 1.53%, 0.67%, and 0.70~~%.~~ %, respectively. Besides that, ~~its~~ the nutrient availability ~~as plant nutrients~~ in the soil, especially P is ~~slowly available~~also slow~~,~~. ~~especially P nutrients.~~ The P has a role ~~of the P element~~ in flower formation ~~influences the formation~~ and size of cob ~~because the~~as cob is the development of female flowers. Therefore the formation of cobs did not develop optimally. Kuswandi (2007) ~~reports~~ reported that P is necessary to encourage the formation of flowers and fruit.~~,~~ ~~it is necessary to have P. element.~~ Thus, in corn plants, the formation of ~~maximum~~ more number of cobs ~~is very necessary for~~needs balanced fertilization. Iskandar (2010) ~~explains~~ explained that the use of a balanced inorganic fertilizer ~~can~~ could increase the growth and ~~product~~ yield of corn. ~~and can provide high levels of corncob production.~~

Increased ~~production~~ seed ~~-~~yield of corn by inorganic fertilization ~~treatment~~ ranged from 17~~,~~.25-25.06% as compared to organic fertilizer~~s~~. ~~In the treatment of~~Although P_1, ~~although the pollution is~~was assisted with *T. Laeviceps* pollination, ~~and~~ the application of organic fertilizer, recorded the lowest production~~,~~. ~~this~~ This ~~is~~ may be due to ~~the~~ lower length and ~~of the cob, the~~ diameter of the cob ~~and~~ besides fewer ~~the smallest~~ number of co~~m~~bs. Pollination ~~on the~~in corn ~~crop~~ to the tune of 95% ~~of the pollination process comes~~ is due to ~~from the~~ pollens from ~~of~~ other plants. Therefore, ~~with the help of~~ the wind can help the pollination (Paliwal, 2000).

~~Weight per cob~~Cob weight, ~~Weight of~~ 100 seed weight~~s~~ and ~~Product~~ Seed yield per plot~~,~~

Average weight ~~per~~ of cob, 100 ~~seeds~~ seed weight and ~~product~~ seed yield per plot with various fertilization and pollination treatments are presented in Table 2. The results showed that P_1 treatment ~~showed~~ recorded the lowest weight ~~per~~ of cob, ~~the~~ weight of 100 seeds and ~~products~~ yield per plot ~~were lowest and were significantly different from~~as compared to other treatments. P_3 treatment ~~(another pollinator) provides~~recorded the highest ~~results~~ values of ~~the observation parameter weight per plot~~weight of cob, ~~the~~ weight of 100 seeds and ~~product~~ seed yield per plot.

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The fertilizer application ~~assisted by~~along with pollinator *T. laeviceps* ~~and other pollinators~~ ~~can~~ could increase the weight ~~per~~ of cob, ~~west~~ weight 100 seeds, and ~~product~~ seed yield per plot. This ~~can~~ could be ~~seen~~ observed in the treatments P_2 and P_3 which ~~are~~ were significantly ~~different from the~~higher as compared to treatment ~~P_0~~ P_0 where ~~(~~pollination was with the help of wind~~)~~ alone. Increased ~~production~~ corn yield due to~~by~~ *T. laeviceps* and other pollinator ranged from 3, 98~~–~~6.66% as compared to wind pollination.

Di-Giovanni *et al.*~~,~~ (1~~-~~995) ~~explained, because~~reported that the size of corn pollen is large and heavy, the ability of the wind to fly pollen is not too far away. Therefore pollinator services are needed. However, ~~because~~ as pollinator ~~access to~~ visit to flowers is not very ~~relevant~~ common (there is no nectar in corn), pollinator assistance to help the pollination process does not work as it should.

Insects, such as bees, have been observed to collect pollen from corn tufts, but they do not play an important role in cross-pollination ~~because~~ as there is no incentive to visit female flowers (Ray~~-~~n~~-~~or *et al.*, 1972~~,). , Added by~~ Silveira~~-~~ Neto *et al.*, ~~(~~1976~~):~~, and Wiese, 2000). Only bees of *A. mellifera* species ~~that~~ constantly visit the male flowers of corn plants (86.11% - 100%).

CONCLUSION

~~Fertilization~~ Application of inorganic fertilizer in corn ~~is given mainly inorganic fertilizers, where there is~~recorded an increase in cob length, ~~ear~~ cob diameter, number of co~~m~~bs, weight ~~per~~ of ~~ear~~ cob and ~~an~~ increase in ~~the product of~~seed yield ranging 17~~,~~25 - 25.06% as compared to organic fertilizer. The role of pollinators ~~to help the process of~~in pollination in ~~Corn~~ corn is not very relevant. Increased corn crop production due to the help of *T. laeviceps* pollinator and other pollinators ranged from 3~~,~~98 -6.66% compared to wind pollination.

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Table 1. Average length of tongko, diameter of cob and number of corn combs with various treatments

Treatment	~~Long~~ Cob Lenght (cm)	~~Diameter~~ Cob diameter (cm)	~~amount~~No. of Co~~m~~bs/ ~~(~~row~~)~~
P ~~0~~0	16.23 [a]	5.35 [a]	15.78 [a]
P_1	14,470 [b]	5.08 [b]	14,67 [b]
P_2	16.38 [a]	5,21 [a b]	15.78 [a]
P_3	16.85 [a]	5,31 [a]	16.22 [a]

[a, b, c, d] Different superscripts in the column show very significant differences (P <0.01)

~~P0~~ P_0 (Inorganic fertilizer and wind pollination), P_1 (Organic fertilizer and pollination by *Trigona laeviceps*, P_2 (Inorganic fertilizer and pollination by *Trigona laeviceps*, P_3 (Inorganic fertilizer and pollination by other pollinators).

Table 2. Average weight per cob, weight of 100 seeds and weight per variety of corn plots Treatment

Treatment	Weight ~~per~~ of Cob (g)	100 seed weight ~~Seed Grain~~ (g)	~~Weight per~~Seed yield per Plot (kg)
P ~~0~~0	261.89 [b]	33.30 [c]	9,910 [c]
P_1	223.35 [c]	31.27 [d]	8,690 [d]
P_2	264.20 [b]	34.73 [b]	11,540 [b]
P_3	279.33 [a]	38.48 [a]	12,090 [a]

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Dewirman Prima Putra

Department of Agrotechnology,
Faculty of Agriculture,
Universitas Ekasakti, Padang 25112
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Question Maks 4 Word
Jawaban / Answer :
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Tujuan Penggunaan Dana/Purpose of fund :

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Jenis ID / ID Type : KTP ☐ SIM ☐ PASSPOR ☐
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Tanggal Terbit ID / ID Issued Date :
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Kota / City :
Propinsi / State :
Kode Pos / Post Code :
Negara / Country :

ALAMAT DOMISILI / DOMICILE ADDRESS

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Kota / City :
Propinsi / State :
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No Telepon/ Telephon No :
Tanggal Lahir/ Date of Birth :
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Trx ID : 2500000-34/20/000224
Sender ID : 250002000104959 Customer No : 1371091012610003
Sender Name : Mr. DEWIRMAN PRIMA PUTRA Phone : 081363303821
KOMP PELANGI INDAH BLOK B5
KORONG GADANG KURANJI
Receiv ID : 250002000104959 Customer No :
Receiv Name : GAURAV GUPTA Phone :
KARNAL HARYANA
KARNAL / INDIA
Source Fund : TABUNGAN Question :
Purpose Fund : DUKUNGAN KELUARGA/BIAYA HIDUP Answer :

Principal	: Rp.	5.418.000,00
Exchange Rate	:	0.0048880
Expected Payout	: INR	26.483,00
Total Charge	: Rp.	90.000,00
Discount	: Rp.	0,00
Total Collect Amount	: Rp.	5.508.000,00

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