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THE SHIFTING OF WEED COMPOSITIONS AND BIOMASS PRODUCTION IN SWEET CORN FIELD TREATED WITH ORGANIC COMPOSTS AND CHEMICAL WEED CONTROLS

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ABSTRACT

The objectives of the research were to study the shift of weed compositions in sweet corn field treated with organic compost and chemical weed controls and to compare the effect of treatment combinations on weed growth, weed biomass and sweet corn biomass. The research was conducted in Bengkulu, Indonesia, from April to July 2014. Results showed that the number of weed species decreased after the trials from 14 to 13. There was a shift in weed compositions because 5 species of weeds did not emerge after the trials, but 4 new species were found. Chemical weed control used a herbiside mixture of atrazine and mesotrione applied during postemergence was the most effective method to control weeds, which was observed on decreased weed emergence and weed biomass down to 22.33 and 25.00 percent of control, respectively. Subsequently, biomass production of sweet corn increased up to 195.64 percent at the same trials. Biomass of weeds and sweet corn were also affected by the organic composts. Weed biomass was inhibited by treatment of composted empty fruith bunches of oil palm, whereas significantly increased of sweet corn biomass were observed in the plots of organic manure.

Keywords: atrazine; biomass production; mesotrione; organic compost; weed composition

INTRODUCTION

Sweet corn (*Zea mays saccharata* Sturt) has been cultivated in Indonesia since early of 1970s but the yield remained low (around 4 – 5 ton ha^{-1}) compared to other corn-producing countries such as the USA and China (Duvick and Cassman, 1999). Many obstacles were encountered in sweet corn production, such as infertile soil which is low in organic matter content, ineffective culture practices, and an imprecise method of weed control resulting in adverse crop competition (Duvickand Cassman*,* 1999; Hasanuddin, 2013). Efforts to improve cultivation practices have been done in order to increase crop yields, but these may result in adverse effects to the environment such as shifting the composition of vegetations or the decrease of biological diversity (Rahman *et al.,* 2001; Edesi *et al.*, 2012). Two cultural practices commonly done in the intensification of sweet corn are using of organic compost to improve soil fertility and application of a precise method of weed control (Sary *et al.*, 2009).

Soil organic matter is materials in the soil derived from organisms which have been decomposed or undergoing the process of decomposition (Troeh and Thompson, 2005). Organic materials can be a source of nutrients for plants through the mineralization process such as NH_4, NO_3, SO_4, PO_4 (Troeh and Thompson, 2005). Less fertile arable soil has low organic matter content and is less optimum for growing sweet corn. Addition of organic matter can increase fertillity of top soil, increase population of microorganisms, and enhance absorption of water (Brown and Cotton, 2011). However, the addition of organic matter may also inhibit the activity of soil-applied herbicides (Monaco *et al.,* 2002; Troeh and Thompson, 2005).

Several types of organic materials that can be used are animal manure, green plants, weeds or crop residues such as waste from

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empty fruit bunches of oil palm, known as EFB (Simanungkalit, 2006). Use of manure compost can increase growth and yield of crops such as corn, wheat, and many horticulture crops (Simanungkalit, 2006; Sary *et al*., 2009). A negative effect of using manure is the increase of weed emergence because of the rapid increase of soil fertility. The use of manure can also enhance the growth of weeds because some weed seeds remain viable in the manure, such as seeds from *Cyperaceae* and *Gramineae* families (Sary *et al.,* 2009; Monaco *et al.,* 2002).

Empty fruit bunches of oil palm (EFB) are the waste of oil palm plant, which accounted for 22–23 % of the processing of fresh fruit bunches (Darnoko, 1993). EFB are often simply dumped around the plant, but in some places it has been used as mulch or processed into compost. EFB possesses a high C/N ratio (more than 45%), therefore this high level of C/N ratio needs to be reduced by composting EFB before using it (Darnoko, 1993; Mansor and Ahmad, 1991).

Weeds area major problem in agriculture due to crop yield reduction caused by competition for the same necessities of life such as water, nutrients, light, CO2, and space (Monaco *et al.,* 2002). Uncontrolled weeds may decrease crop yield between 20–80 % (Tjitrosoedirdjo *et al.,* 1984; Monaco *et al.,* 2002). The main goal of weed control is to change the ecological circumstances aimed to suppress weeds but on the other hand have positive effect to the crops (Monaco *et al*. 2002). One method of weed cont-rol is chemical control using herbicides to inhibit or kill the weeds. Some advantages of using herbicides are that it may be applied as early as possible before adverse effects of weeds com-mence, it can prevent damage to plant roots, it is more effective in killing perennial weeds, and it is more practical with minimal labor requirements (Rahman *et al*., 2001; Monaco *et al*. 2002). Using one type of herbicide for long-term periods can result in resistant weeds, thus it is necessary to rotate the herbicide or to mix with other herbicides with a different mechanism (James *et al.,* 2006; Woodyard *et al*., 2009).

Herbicide mixture is sold as a package in a trade material, such as a mixture of atrazine and mesotrione (500 g l^{-1} + 50 g l^{-1}) (Woodyard *et al*., 2009). This mixture is a selective herbicide for corn, wheat, sorghum and sugarcane which can be applied during pre-emergence or post-emergence (James *et al.,* 2006; Schooler *et al.,* 2008; Woodyard *et al.,* 2009). Atrazine (*2-chloro - 4 - ethylamino - 6 - isopropylamino -1,3,5 -triazine*), included in the family of triazine, inhibits electron transfer in photosystem II, so that weeds exposed to atrazine will undergo chlorosis on leaves followed by necrosis and death (Muller, 2008). Because atrazine has been used intens-ively for a long time, many species of weeds were reported to become resistant, such as *Altern-anthera* sp. and *Amaranthus* sp. (Schooler *et al.,* 2008; Williams*et al.,* 2010). Mesotrione {*2-[4-(me-thylsulfonyl)-2-nitro-benzonyl]cyclohexane-1,3 dio-ne*}, a relatively new herbicide and a member of the family of triketone, is effective to control weed spe-cies that are resistant to atrazine (James *et al.,* 2006). Mesotrione inhibits a carotene pigment in plant tissue. The symptoms are losing of green color on leaves, bleaching and death (James *et al*., 2006; Schooler *et al*., 2008).

Application of organic materials or chemical weed controls in cropping fields may affect growth and composition of weeds (Edesi *et al.,* 2012). Organic materials can increase soil fertility and stimulate the growth of weeds (Troeh and Thompson, 2005). Chemical weed control using herbicides is effective to eliminate those weeds, but the remaining weed seeds in the soil will germinate and grow extensively (Rahman *et al.,* 2001). Shifting the vegetations are always pre-dicted whenever agricultural practices applied in cropping system (Fitriana *et al*., 2013; Sharma and Banik, 2013).

The objectives of this experiment were to study the shifting of weed compositions in the sweet corn field treated with organic composts and chemical weed controls using a package of herbicide mixure of atrazine and mesotrione ap-plied during preemergence and postemergence, to compare effects of chemical weed controls in sweet corn field treated with organic composts on weed growth, weed biomass and sweet corn biomass production.

MATERIALS AND METHODS

The present research was conducted in the Experimental Station of the Agricultural Faculty of the University of Bengkulu from April to July 2014. The research was carried out in a split plot design arranged in blocks. The main plot was three types of compost including the application of composted organic materials from cow manure (10 t ha^{-1}), empty fruit bunches of oil palm (20 t ha^{-1}), and without organic compost as a control. The subplots consisted of 4 weed control methods including a package of herbicide mixture of atrazine and mesotrione applied during preemergence, post-emergence, hand weeding twice at 14 and 28 days after planting (DAP), and unweeded as a control. Twelve treatment combinations were assigned, each was 3 replicates. Dose of a herbicide package is 1.0 kg a.i. ha^{-1}, preemergence was applied to the soil surface one day prior to planting and postemergence was applied on crops and weeds 14 DAP. Herbicide were delivered by a backpack sprayer in a volume of 400 L ha^{-1} at the pressure of 15 psi.

Land was prepared conventionally through 2 manual ploughing at the depth of 20 cm and leveling then divided into 36 experimental plots of 3.0 m x 1.6 m size. Distance between the main plot was 50 cm and between block was 1.0 m. Composted organic materials were applied 1 week before planting by mixing the compost evenly with top soils of each plot of 20 cm. Two corn seeds of var. Sweet Boy were planted in the planting hole of 5 cm depth and 5 pcs. of Carbofuran granules were added into the hole to prevent the seed from insects. Planting distance was 75 cm x 20 cm.

Fertilizers were applied in a furrow 10 cm away from the seed holes. Fertilizers used were Urea (46 % of N), Super-phosphate (36 % of P_2O_5) and KCl (60 % of K_2O) at the dose of 400, 300, and 250 kg ha^{-1}, respectively. Urea was applied twice, 1/3 dose was applied at planting and other 2/3 dose was applied at 4 weeks after planting (WAP), whereas Super-phosphate and KCl were applied once during at planting. Maintenance of the crops includes watering of plants if there was no rain 3 days in a row, thinning of one plant per hole at 2 WAP, weeding as similar as the treatment trials, pest and disease control carried out in accordance with the results of scouting, and harvesting at 65 DAP or when the sweet corn kernel reached the mature stage.

Data were observed on weeds and sweet corn plants. Weed analysis were conducted before land preparation and after corn was harvested. Observed variables of weed analysis included density, frequency, and dominance of each species. The growth of weeds were also observed in the field including weed emergence and total biomass. Weed emergence were observed at 1, 4 and 7 WAP using scores of 0 to 5, where a score of 0 = 0–10 %, 1 = 11–20 %, 2 = 21–30 %, 3 = 31–40 %, 4 = 41–50 %, and 5 = > 50 % of plot surface covered by weeds. Weed biomass and sweet corn biomass production were harvested at 65 DAP. Data of weed emergence, weed biomass and sweet corn biomass production were subjected to analysis of variance (ANOVA) and means were separated by least significant differences (LSD) test at 5 % level. Data of density, frequency and dominance of weeds were used to calculate summed dominance ratio (SDR) (Tjitrosoedirdjo *et al.,* 1984), while density of weed species was used to calculate Shannon-Weiner diversity index (H) and Sorensen similarity index (Ss) (Spellerberg and Fedor, 2003), as described in equation [1], [2], and [3].

$$SDR = \frac{RD + RF + RD'}{3} \qquad [1]$$

where RD is the relative value of weed density, FR is the relative value of weed frequency, and RD' = relative value of weed dominance. Relative values were the proportion of observed data of each species to the total data in one plot.

$$H = -\sum_1^n \left\{\frac{ni}{N} Ln\frac{ni}{N}\right\} \qquad [2]$$

Where *ni* is the number of individual of spesies *i*, N is the total numbers of all individuals in one plot.

$$Ss = \frac{2C}{A+B} \qquad [3]$$

Where C is the number of same species found in both habitats A and B, A is the number of species in habitat A, and B is the number of species in habitat B

RESULTS AND DISCUSSIONS

Weed Compositions

Results of analysis of vegetation in early trials showed 14 species of weeds at the site of the study consisted 9 species of broadleaves and 5 species of grasses (Table 1). The predominant weeds based on SDR value were *Imperata cylindrica* (15.03), *Paspalum conjugatum* (12.33), *Axonopus compressus* (12.14) and *Borreria palustris* (10.61). At the end of the study, the total number of weed species decreased to 13, and the dominant weeds shifted to *Borreria leavis, Borreria palustris, Peuraria javanica,* and *Syndrella nodiflora*. Five weed species which did not appeared at the end of the study were *Eupatorium odoratum, Ishaemum timorense, Melastoma affine, Porophyllum ruderale,* and *Richardia brasiliensis*. There were 4 new species that grew after the trials, namely *Ageratum conyzoides, Eleusine indica, Phyllanthus urinaria,* and *Syndrella nodiflora* (Table 1).

Changes in weed compositions might possibly due to change in the microecosystem after various disturbances to soil such as tillages, addition of organic materials and application of herbicides (Rahman *et al.,* 2001; Fitriana *et al*., 2013; Sharma and Banik, 2013). The emergence of new weed species might occur because of lifted weed seeds from the soil which then grew after cultivation. Soil was known as seed-bank of weeds. Seeds remained in a dormant state in the soil for long periods of time (Rahman *et al.,* 2001). Lifting the seeds and exposing them to sunlight would stimulate their germination. Some weed species did not grow anymore due to the immersion of seeds at the time of soil cultivation or died as a result of weed control measures applied (Monaco *et al*., 2002; Edesi *et al.,* 2012). On the site of experiment, *Borreria palustris* remained predominant before and after trials, while the dominance ratio of some weeds were increasingly visible such as *Borreria leavis* and *Syndrella nodiflora* (Table 1). SDR values of some weeds such as *Axonopus compressus* and *Paspalum conjugatum* were not consistent among the trials.

Diversity Index (H) of the weed communities in the experimental site before land preparation was 2.37 (Table 2), which is classified as medium category (Spellerberg and Fedor, 2003). Treatment combination between composted organic materials and chemical weed controls using a herbicide mixture of atrazine and mesotrione decreased the diversity index to the ranges of 2.00 to 2.35, which classified in the medium category. Diversity of weeds after trials for one growing season declined by the ranged of 0.02 to 0.37. Shifting of weed diversity were caused by treatment combination may have occured but it was only limited in one season. Rahman *et al.,* (2001) and Edesi *et al.,* (2012) observed the dynamic of weed species diversity after five year trials by conventional and organic farming, but the shifts of weed diversity was found in one growing season with herbicide treatments.

Similarity index of weeds in sweet corn field treated with organic compost and chemical weed control are presented in Table 3. Overall, similarity index of weed communities were in the range of 62 to 91 %, which fall into moderate to high similarity (Spellerberg and Fedor, 2003). Further analysis of these indexes was performed and presented as a dendogram (Figure 1). Some treatments which indexes were more than 85 percent were among the plots of unweeded (OC, MC, and TC) and the plots of organic manure application (MC, MH1, and MHw); two plots of postemergence herbicide (OH2 and TH2). The rest ofthe trials performed a moderate similarity which had a similarity index of 62 to 83 %.

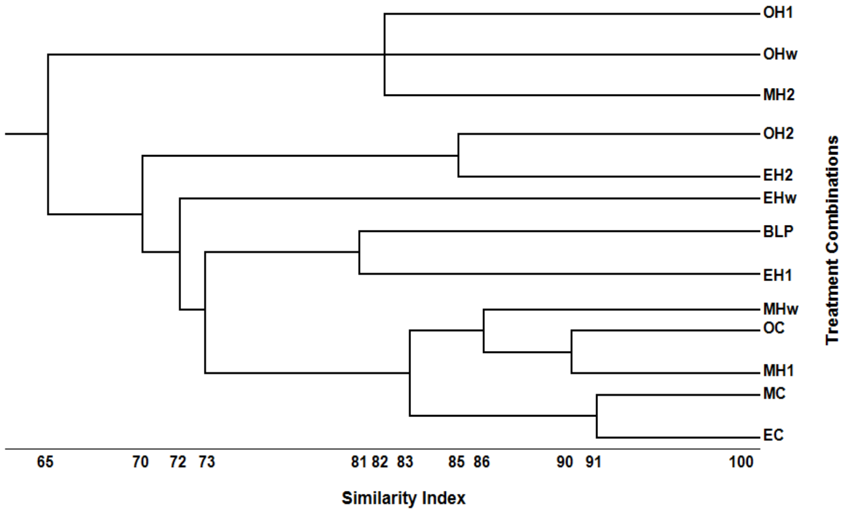

Figure 1. Dendogram based on similarity indexes of weed populations. BLP: before land preparation, O: no organic compost, M: manure compost, E: EFB compost, C: unweeded as a control, H1: herbicide mixture of atrazine and mesotrione applied preemergence, H2: herbicide mixture applied postemergence, Hw: hand weeding twice (14 and 28 days after planting)

Table 1. Summed dominance ratio (SDR) of weed communities in corn field before land preparation and after sweet corn harvested

No	Weed Spesies	Group [1]	Summed Dominance Ratio (SDR) (%) [2]												
			BLP	OC	OH1	OH2	OHw	MC	MH1	MH2	MHw	EC	EH1	EH2	EHw
1	*Ageratum conyzoides*	B	-	3.91	-	-	5.41	5.34	2.30	-	5.98	3.86	-	-	3.84
2	*Axonopus compressus*	B	12.14	8.97	9.00	13.82	10.33	8.52	7.19	7.56	8.74	8.85	7.37	13.80	9.62
3	*Borreria leavis*	B	4.33	12.65	12.86	11.02	11.96	11.94	11.14	15.64	13.56	12.42	16.82	13.53	14.24
4	*Borreria palustris*	B	10.61	10.29	14.76	10.51	9.68	10.52	12.70	11.99	10.08	10.42	13.02	10.78	11.22
5	*Digitaria sanguinalis*	G	4.33	6.34	3.76	7.47	6.23	5.16	4.90	7.29	5.56	6.27	3.91	11.14	6.07
6	*Eleusine indica*	G	-	6.35	4.92	5.43	6.34	6.11	7.39	-	8.43	-	3.29	-	3.84
7	*Eupatorium odoratum*	B	3.28	-	-	-	-	-	-	-	-	-	-	-	-
8	*Imperata cylindrica*	G	15.03	3.04	8.38	4.47	7.39	7.34	7.19	4.42	6.32	8.85	6.98	7.04	7.06
9	*Ischaemum timorense*	G	9.13	-	-	-	-	-	-	-	-	-	-	-	-
10	*Melastoma affine*	B	2.97	-	-	-	-	-	-	-	-	-	-	-	-
11	*Mimosa pudica*	B	4.93	5.83	3.18	-	7.07	2.35	4.08	-	5.58	6.84	6.96	-	5.28
12	*Paspalum conjugatum*	G	12.33	5.83	10.01	15.49	8.69	6.60	8.02	6.02	10.27	6.91	10.08	10.33	9.24
13	*Phyllanthus urinaria*	B	-	5.83	5.19	7.29	-	7.58	5.83	6.65	3.26	4.57	3.29	3.16	3.24
14	*Porophyllum ruderale*	B	4.63	-	-	-	-	-	-	-	-	-	-	-	-
15	*Pueraria javanica*	B	7.50	12.65	9.00	9.50	10.33	10.65	10.63	15.12	9.74	12.28	11.84	11.75	9.81
16	*Richardia brasiliensis*	B	4.48	-	-	-	-	-	-	-	-	-	-	-	-
17	*Stachytarpheta indica*	B	4.33	3.04	2.61	7.83	-	3.96	3.75	7.93	-	3.30	4.92	5.78	-
18	*Syndrella nodiflora*	B	-	15.27	16.33	7.17	17.61	13.95	14.88	15.25	14.48	15.43	11.43	12.72	16.55
Total number of species			14	14	13	13	11	12	12	13	11	13	12	13	11

Remarks: [1] B: Broad leaves, G: Gramineae, [2] BLP: before land preparation, O: no organic compost, M: manure compost, E: EFB compost,C: unweededas a control, H1: herbicide mixture of atrazine and mesotrione applied preemergence, H2: herbicide mixture of atrazine and mesotrione applied postemergence, Hw: hand weeding twice (14 and 28 days after planting).

Table 2. Diversity Index of weed communities (Shannon-Weiner Index) before land preparation and after sweet corn harvested

No	Weed Spesies	Group[1)]	Diversity Indexes [2)]												
			BLP	**OC**	**OH1**	**OH2**	**OHw**	**MC**	**MH1**	**MH2**	**MHw**	**EC**	**EH1**	**EH2**	**EHw**
1	*Ageratum conyzoides*	B	-	0.09	-	-	0.12	0.14	0.06	-	0.14	0.08	-	-	0.09
2	*Axonopus compressus*	B	0.27	0.22	0.21	0.25	0.24	0.21	0.19	0.25	0.21	0.21	0.18	0.27	0.22
3	*Borreria leavis*	B	0.11	0.28	0.28	0.23	0.30	0.24	0.22	0.31	0.26	0.29	0.33	0.26	0.31
4	*Borreria palustris*	B	0.26	0.25	0.31	0.22	0.31	0.21	0.23	0.26	0.17	0.23	0.29	0.20	0.26
5	*Digitaria sanguinalis*	G	0.11	0.16	0.08	0.18	0.12	0.13	0.07	0.16	0.14	0.15	0.09	0.24	0.14
6	*Eleusine indica*	G	-	0.16	0.11	0.12	0.12	0.15	0.08	-	0.10	-	0.07	-	0.09
7	*Eupatorium odoratum*	B	0.07	-	-	-	-	-	-	-	-	-	-	-	-
8	*Imperata cylindrica*	G	0,32	0.07	0.18	0.10	0.08	0.19	0.15	0.09	0.16	0.22	0.16	0.09	0.10
9	*Ischaemum timorense*	G	0.22	-	-	-	-	-	-	-	-	-	-	-	-
10	*Melastoma affine*	B	0.06	-	-	-	-	-	-	-	-	-	-	-	-
11	*Mimosa pudica*	B	0.13	0.14	0.07	-	0.15	0.05	0.12	-	0.10	0.16	0.17	-	0.12
12	*Paspalum conjugatum*	G	0.29	0.14	0.23	0.30	0.14	0.17	0.21	0.09	0.24	0.13	0.23	0.34	0.22
13	*Phyllanthus urinaria*	B	-	0.14	0.11	0.14	-	0.19	0.16	0.15	0.10	0.11	0.07	0.07	0.07
14	*Porophyllum ruderale*	B	0.12	-	-	-	-	-	-	-	-	-	-	-	-
15	*Pueraria javanica*	B	0.19	0.28	0.21	0.22	0.19	0.22	0.21	0.30	0.16	0.28	0.27	0.27	0.21
16	*Richardia brasiliensis*	B	0.11	-	-	-	-	-	-	-	-	-	-	-	-
17	*Stachytarpheta indica*	B	0.11	0.07	0.05	0.08	-	0.19	0.07	0.18	-	0.07	0.11	0.13	-
18	*Syndrella nodiflora*	B	-	0.32	0.33	0.16	0.34	0.27	0.26	0.25	0.32	0.32	0.26	0.26	0.33
	Diversity Indexes (H)		2.37	2.32	2.17	2.00	2.11	2.35	2.01	2.04	2.10	2.25	2.23	2.14	2.16

Remarks: [1)] B: Broad leaves, G; Gramineae, [2)] BLP: before land preparation, O: no organic compost, M: manure compost, E: EFB compost, C: unweeded control, H1: herbicide mixture of atrazine and mesotrione applied preemergence, H2: herbicide mixture of atrazine and mesotrione ap postemergence, Hw : hand weeding twice (14 and 28 days after planting).

Table 3. Similarity Index of weed populations (%) before land preparation and after sweet corn harvested

Treatment Combin-ations [1)]	BLP	OC	OH1	OH2	OHw	MC	MH1	MH2	MHw	EC	EH1	EH2	EHw
BLP	100	77	79	77	76	74	74	76	76	81	81	78	79
OC		100	84	82	85	83	90	79	86	89	83	82	82
OH1			100	73	82	70	82	82	73	81	78	81	71
OH2				100	76	62	81	71	77	74	77	86	70
OHW					100	74	75	73	84	77	74	63	79
MC						100	88	79	86	91	73	77	73
MH1							100	75	88	86	81	75	79
MH2								100	66	82	65	84	71
MHW									100	84	79	72	80
TC										100	80	81	81
TH1											100	71	72
TH2												100	72
THW													100

Remarks: [1)] BLP: before land preparation, O: no organic compost, M: manure compost, E: EFB compost, C: unweeded as a control, H1: herbicide mixture of atrazine and mesotrione applied preemergence, H2: herbicide mixture of atrazine and mesotrione applied postemergence, Hw: hand weeding twice (14 and 28 days after planting).

Weed Emergence

Emergence of weeds in sweet corn field were observed as percent of plot surface covered by weeds. At the age of 1 WAP, herbicide mixture of atrazine and mesotrione without and with organic materials suppressed weed emergence down to 0.67–1.00 % (Table 4). Herbicide applied during preemergence inhibited seed germination so that weeds did not emerge in the plots (Muller, 2008). Atrazine is a herbicide that can be applied during preemergence and postemergence, active through soil and also through the leaf surface (Monaco *et al*., 2002; Muller, 2008). Application of herbicide to the soil surface will inhibit germination of weed seeds, but some resistant weeds still germinate lately (Muller, 2008; Williams *et al.,* 2010). This was showed at 4 WAP where the weed emergence on plots of preemergence herbicide treatment increased to the range of 5.67–7.33 % (Table 4). Meanwhile, weeds emergence at postemergence herbicide treatment plots depressed significantly to the range of 0.33–1.00 %. By hand weeding, weed emergence were higher up to 8.33–10.00 % which may likely due to no injury effects caused by hand weeding and weed seeds were possibly lifted up at the time of weeding and continued germinating (Fitriana *et al*., 2013; Hasanuddin, 2013; Sharma and Banik, 2013).

At 7 WAP or one week prior to harvesting, the least weed emergence was observed in postemergence herbicide treatment plots with a score range of 22.33–25.67 %, followed by hand weeding and premergence herbicide with a score range of 33.67–38.00 % and 46.00–47.33 %, respectively. Herbicide mixture of atrazine and mesotrione applied during postemergence or at 2 WAP showed efficacy up to 7 WAP, thus it has more suppresive control effect indicated by the least emergence of weeds. In the postemergence treatment, herbicide solutions was sprayed directly to leaf surfaces to allow a more optimumherbicide activities. In contrats, activities of herbicide mixture applied to the soil surface might be influenced by many factors such as soil particles adsorption and climate factors such as rain splash that may cause herbicide undergo leaching (Monaco *et al*., 2002; Muller, 2008; Woodyard *et al.,* 2009). At the unweeded plots, weed emergences were 71.33, 76.33, and 70.00 % with no organic compost, cow manure and EFB compost, respectively. The emergence of weeds were significantly higher in the main plot of cow manure than other main plot treatments. This is a negative effect of using cow manure because of the rapid increase of the soil fertility so that weeds emerged and covered the plots. Also, some weed seeds remained viable in the cow manure such as groups of *Cyperacea* and *Gramineae* (Sary *et al.,* 2009).

Table 4. Weed Emergence in sweet corn field after treated with organic compost and chemical weed controls

Organic Compost[1)]	Weed Emergence (%)[2)]											
	C	**H1**	**H2**	**Hw**	**C**	**H1**	**H2**	**Hw**	**C**	**H1**	**H2**	**Hw**
	----- 1 Weeks After Planting -----				**----- 4 Weeks After Planting -----**				**----- 7 Weeks After Planting -----**			
O	3.00 a A	0.67 a B	3.67 a A	4.00 a A	14.33 a A	5.67 b C	0.33 a D	8.33 b B	71.33 b A	47.33 a B	23.67 b D	38.00 a C
M	3.33 a A	1.00 a B	3.33 a A	4.67 a A	14.33 a A	7.33 a B	1.00 a D	10.00a B	76.33 a A	46.00 a B	25.67 a D	37.67 a C
E	2.67 a AB	1.00 a B	4.00 a A	3.67 ab A	14.67 a A	6.33 ab C	1.00 a D	9.33 ab B	70.00 b A	47.33 a B	22.33 b D	33.67 b C

Remarks: [1)] O: no organic compost, M: manure compost, E: EFB compost; [2)]C: unweededas a control, H1: herbicide mixture of atrazine and mesotrione applied preemergence,H2: herbicide mixture of atrazine and mesotrione applied postemergence, Hw: hand weeding twice (14 and 28 days after planting). Numbers followed by the same lowercase and uppercase letters are not significantly different by LSD test ($P<0.05$) within a column and a row, repectively.

Table 5. Weed biomass in sweet corn field treated with organic composts and chemical weed control.

Organic Compost[1)]	Weed Biomass [2)]							
	C	H1	H2	Hw	C	H1	H2	Hw
	----------------(gram m^{-2})------------------				----------- (% of Control) -----------			
O	2122.88 a A	909.31 a B	546.60 a C	896.24 a B	100.00	42.83	25.75	42.21
M	2200.88 a A	815.65 a B	550.11 a C	825.83 a B	100.00	37.06	25.00	37.52
E	1690.55 b A	638.98 b C	451.93 a C	850.51 a B	100.00	37.80	26.73	50.31

Remarks:[1)] O: no organic compost, M: manure compost, E: EFB compost; [2)] C: unweeded as a control, H1: herbicide mixture of atrazine and mesotrione applied preemergence, H2: herbicide mixture of atrazine and mesotrione applied postemergence, Hw: hand weeding twice (14 and 28 days after planting). Numbers followed by the same lowercase and uppercase letters are not significantly different by LSD test ($P<0.05$) within a column and a row, repectively.

Biomass Production

Addition of organic composts combined with chemical weed controls showed interaction on biomass production. Herbicide mixture of atrazine and mesotrione applied during preemergence and postemergence, and hand weeding suppressed the production of weed biomass in all organic matter treatments (Table 5). The most suppressed weed biomass was observed in postemergence herbicide trial which was evident in the decreased of weed biomass down to 25.00, 25.75 and 26.73 % with no organic compost, organic manure, and EFB compost, respectively. Manure compostby itself did not affect weed biomass, but EFB compost by itself suppressed weed biomass from 2212.88 down to 1690.55 g m^{-2}. These interactions were also found with preemergence herbicide trial, where EFB compost suppressed weed biomass from 909.31 to 638.96 g m^{-2}. This is the strong evidence to indicate that composted EFB has a herbicidal potentials to inhibit weeds.

Weed biomass production declined through chemical weed control treatments using a herbicide mixture of atrazine and mesotrione were also reported by Schooler *et al.,* (2008) and Hasanuddin (2013). This mixture had been introduced to overcome the problem of atrazine resistant weeds and was recommended as a selective herbicide for corn, wheat, and sorghum (James *et al.*, 2006; Woodyard *et al.,* 2009). Compared to preemergence application, post emergence aplication performed longer persintence so that it was more efective to control young emerged weeds. This was because preemergence application only inhibited seed germinations, so that the late germinated weed seeds will survive from preemergence herbicide application (Schooler *et al.*, 2008; Woodyard *et al.,* 2009).

Biomass productions of sweet corn were affected significantly by the interaction of organic matter and chemical weed control (Table 6). Controlling weeds with herbicide mixture of atrazine and mesotrione applied during pree-mergence, postemergence, and hand weeding can increase biomass production of sweet corn significantly in all organic compost plots. Compared to unweeded plot, the highest increase of biomass productions was observed on post-emergence herbicide trials, reaching 179.14, 180.21, and 195.64 % at the plot with no organic matter, cow manure, and EFB compost, respectively (Table 6). Organic manure itself increased the biomass production significantly, but composted EFB did not affect biomass production. The highest biomass production of sweet corn was observed in the interaction of an organic manure with herbicides mixture of atrazine and mesotrione applied during postemergence, reaching 4014.95 g m^{-2}.

Table 6. Biomass production of sweet corn treated with organic composts and chemical weed control.

Organic Compost 1)	Sweet Corn Biomass 2)							
	C	H1	H2	Hw	C	H1	H2	Hw
	(gram m^{-2})				(% of Control)			
O	2103.90 b C	2779.80 b B	3768.97 b A	3150.25 b B	100.00	132.13	179.14	149.73
M	2227.98a C	3050.62a B	4014.95 a A	3355.57 a B	100.00	136.92	180.21	150.61
E	2000.23b C	2985.38 a B	3913.27 ab A	3199.26 b B	100.00	149.25	195.64	159.95

Remarks: 1) O: no organic compost, M: manure compost, E: EFB compost; 2) C: unweeded as a control, H1: herbicide mixture of atrazine and mesotrione applied preemergence, H2: herbicide mixture of atrazine and mesotrione applied postemergence, Hw: hand weeding twice (14 and 4 days after planting). Numbers followed by the same lowercase and uppercase letters are not significant different by LSD test (P<0.05) within a column and a row, repectively.

Herbicide treatment can suppress the emergence and growth of weed, preventing the crops from experiencing strong competition, and the crop will grow and produce a maximum of biomass (Sary *et al.,* 2009). This was evident in the treatment of herbicide applied during post-emergence which increased the production of plant biomass up to 179.14 – 195.64 percent compared with unweeded. In the circumstance of being free from weed competition, the crops will grow quickly by utilizing available resources such as water, nutrients, and space (Monaco *et al*., 2002). Compare to EFB compost, addition of organic manure showed better effect on biomass production of corn. The reason was because EFB compost has a high C/N ratio, which takes more time for composting of EFB to produce available N, P and K (Mansor and Ahmad, 1991; Darnoko, 1993). On the other hand, manure compost were richer inavailable nutrients and also can improve the soil biological properties and soil structure which would be better for plant growth (Simanungkalit, 2006; Brown and Cotton, 2011).

CONCLUSIONS

The decrease in the number of weed species and changes in the predominant weeds indicated shifting of weed communities. Herbicide mixtures of atrazine and mesotrione applied during postemergence strongly suppressed weed growth and biomass down to 22.33–25.67% and 25.00–26.73 %, respectively. Subsequently, biomass production of sweet corn increased up to 179.14–195.64 % with the same trial. The higest improvement of biomass production of sweet corn was observed in the combination of organic manure with a herbicide applied at postemergence.

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