MEKANISME DAN EFEKTIVITAS ASAM ASETAT SEBAGAI HERBISIDA TERHADAP GULMA PADA JAGUNG (*Zea mays* L.)

INTISARI

Kompetisi gulma dengan tanaman jagung menyebabkan kerugian berkaitan dengan penurunan produksi tanaman jagung. Pengendalian gulma dengan herbisida memberikan dampak positif berupa penghambatan pertumbuhan gulma dan peningkatan produksi pertanian. Penggunaan cuka (asam asetat) sebagai herbisida adalah ramah lingkungan, namun belum diketahui secara pasti cara kerjanya. Oleh karena itu dilakukan penelitian "Mekanisme dan Efektivitas Asam Asetat sebagai Herbisida terhadap Gulma pada Jagung (*Zea mays* L.)" dilaksanakan dalam tiga tahap penelitian. Penelitian pertama bertujuan mempelajari pengaruh aplikasi asam asetat pratanam terhadap perkecambahan benih jagung dan pengaruh aplikasi asam asetat pratumbuh terhadap pertumbuhan kecambah gulma dan benih jagung. Penelitian kedua bertujuan untuk mempelajari pengaruh aplikasi asam asetat pascatumbuh terhadap pertumbuhan gulma dan tanaman jagung, serta mendapatkan mekanisme asam asetat pascatumbuh dalam menghambat proses biokimia, fisiologi dan anatomi gulma. Penelitian ketiga bertujuan untuk menentukan waktu aplikasi asam asetat yang efektif mengendalikan pertumbuhan gulma, meningkatkan pertumbuhan dan hasil jagung. Penelitian dilakukan pada bulan Maret 2013 sampai dengan April 2014

Hasil penelitian menunjukkan bahwa (1) aplikasi asam asetat pratanam 10% dan 20% menurunkan perkecambahan jagung dengan menghambat pertumbuhan tajuk. Semakin lama jarak waktu aplikasi dengan waktu tanam, semakin rendah penghambatan perkecambahan jagung. Aplikasi asam asetat pratumbuh 10% dan 20% menghambat perkecambahan jagung dengan merusak membran sel, peningkatan kebocoran elektrolit, penurunan sintesis protein dan laju respirasi sehingga tidak berkecambah. Aplikasi asam asetat pratumbuh 20% mampu menghambat perkecambahan biji gulma semusim, namun tidak menghambat gulma tahunan *Paspalum distichum* dan *Cyperus rotundus*. Fitotoksisitas tanaman jagung termasuk keracunan ringan, sehingga tanaman jagung dapat tumbuh normal; (2) aplikasi asam asetat pascatumbuh 20% menghambat pertumbuhan gulma setara dengan penyiangan mekanis 2 kali dan meningkatkan pertumbuhan tanaman jagung. Aplikasi asam asetat pascatumbuh 20% menghambat gulma *Cleome viscosa* lebih cepat dibandingkan dengan *Cyperus rotundus,* da*n Paspalum distichum*. Mekanisme asam asetat pascatumbuh menghambat gulma melalui membran sel bocor, penurunan konduktansi stomata dan menginduksi penutupan stomata, penurunan laju transpirasi, penurunan serapan CO_2, dan peningkatan O_2, menghambat sintesis protein dan penurunan kadar klorofil sehingga menghambat laju fotosintesis. ATP dan NADPH diduga terakumulasi dalam stroma pada kloroplas, sehingga bereaksi dengan O_2 membentuk superoksida (O_2^-) dan hydrogen peroksida (H_2O_2) di kloroplas. Peningkatan radikal O_2^- dan H_2O_2 menyebabkan peningkatan enzim SOD dan POD merupakan adaptasi ketahanan gulma *Cyperus rotundus* dan *Paspalum distichum.* Peningkatan pembentukan radikal O_2^- dan H_2O_2 pada gulma *Cleome viscosa* menyebabkan penurunan enzim SOD dan POD mengakibatkan kerusakan sel mesofil daun gulma; (3) aplikasi asam asetat pascatumbuh 20% efektif menekan pertumbuhan gulma, menyebabkan pertumbuhan dan hasil jagung setara dengan aplikasi asam asetat pratumbuh + pascatumbuh dan penyiangan mekanis 2 kali. Kompetisi gulma dengan tanaman jagung perlakuan bergulma menyebabkan penurunan hasil jagung tertinggi sebesar 47,67% dibandingkan dengan aplikasi asam asetat pratumbuh + pascatumbuh, pascatumbuh dan penyiangan mekanis 2 kali masing-masing sebesar 19,48% 20,86% dan 16,79%.

Kata kunci: mekanisme, efektivitas, asam asetat, gulma, jagung

MECHANISM AND EFFECTIVENESS OF ACETIC ACID AS HERBICIDES AGAINST WEEDS IN CORN (Zea mays L.)

ABSTRACT

The competition of crop and weed has caused a decrease in corn production. Controlling weeds with herbicides has provided positive effects in the form of weeds growth inhibition and increased agricultural production. The use of vinegar (acetic acid) as herbicide is environmentally benign. However, its working method is not yet known. Therefore, a research on "Mechanism and Effectiveness of Acetic Acid as Herbicides against Weeds in Corn (Zea mays L.)" was conducted in three stages. The first research was to study the effect of a preplanting application of acetic acid on corn germination and the effect of a preemergence application of acetic acid on the growth of weed and corn germination. The second research was to study the effect of a postemergence application of acetic acid on the growth of weed and corn; and to get the postemergence acetic acid mechanism in inhibiting the biochemical, physiological, and anatomical weed processes. The third research was to determine the effective time of acetic acid application in controlling weed growth, improving corn growth, and increasing corn production. The research was conducted from March 2013 to April 2014.

The results show that (1) the preplanting application of 10% and 20% acetic acid has decreased corn germination as it inhibited shoot growth. The longer the distance between the application of acetic acid and the time of planting, the lower the to inhibition corn germination. The preemergence application of 10% and 20% acetic acid has inhibited the corn germination by damaging the cell membrane, increasing electrolyte leakage, and decreasing protein synthesis and respiration rate so that the corn does not germinate. The preemergence application of 20% acetic acid has inhibited the annual weed seed germination, but not from the perennial weeds, Paspalum distichum and Cyperus rotundus. Corn phytotoxicity is a mild toxicity; this makes corn grow normally; (2) the postemergence application of 20% acetic acid has inhibited the growth of weeds equals with two times mechanical weeding, and increased the growth of the corn. The postemergence application of 20% acetic acid has inhibited the weeds Cleome viscosa faster than Cyperus rotundus, and Paspalum distichum. The postemergence mechanism of acetic acid inhibit weeds growth by the cell membrane leaked resulting in a decrease in the stomatal conductance and induce the stomatal closure, causing a decrease in the rate of transpiration and CO_2 absorption, so that the CO_2 concentration low and the O_2 concentration higher in the cell. It then has inhibited protein synthesis and decreased the chlorophyll content those of which have inhibited the photosynthesis rate. It is assumed that the ATP and the NADPH were accumulated in the stroma of chloroplasts. It then reacted with O_2 to form superoxide (O_2) which is toxic and hydrogen peroxide (H_2O_2) which is more toxic in the chloroplasts. The increase radical of O_2^- and H_2O_2 causing increased enzymes of SOD and POD is an adaptation of resistance weeds Cyperus rotundus and Paspalum distichum. The increase radical of O_2^- and H_2O_2 on Cleome viscosa weed has caused a decrease enzymes of SOD and POD creating damage of the mesophyll cells of the weed leaves; (3) the postemergence application of 20% acetic acid was effective to suppress weed growth. It has also improved the growth and corn production equivalent to the preemergence + postemergence applications of acetic acid and two times of mechanical weeding. The competition of weed and corn plant on the treatment without weeding has resulted in the highest decrease of corn production of as much as 47,67% compared to that of those treated with the preemergence + postemergence applications of acetic acid, the postemergence application of acetic acid, and two times of mechanical weeding, i.e. 20,86% and 19,48% 16,79%, respectively.

***Keywords**: mechanism, effectiveness, acetic acid, weeds, corn*