KERING DAN PENGARUHNYA TERHADAP EROSI

Oleh
Aos
NIM : 30611014
(Program Studi Doktor Biologi)

Erosi dapat mempercepat degradasi tanah pada agroekosistem lahan kering berlereng. Kegiatan pengendalian erosi dilakukan melalui pengelolaan tanah dengan pemberian bahan organik dan pengelolaan tanaman dengan menerapkan sistem tumpangsari. Interaksi akar pada tanaman semusim yang ditanam secara tumpangsari dan pengaruhnya terhadap distribusi akar, kualitas tanah, erosi, dan produksi biomassa sangat penting dalam pengelolaan agroekosistem lahan kering berlereng. Penelitian ini bertujuan: (i) mengkaji peningkatan kualitas tanah menggunakan bahan organik lokal, (ii) mengkaji pengaruh kombinasi tanaman semusim dengan sistem perakaran berbeda yang ditanam secara tumpangsari terhadap distribusi akar, kualitas tanah dan erosi, dan (iii) mengkaji pengaruh ruang tumbuh akar dan makrofauna tanah pada tumpangsari terhadap distribusi akar, erosi dan produksi biomassa. Penelitian dilakukan dalam tiga tahap yaitu peningkatan kualitas tanah menggunakan bahan organik lokal, pengaruh tumpangsari terhadap erosi dan distribusi akar pada berbagai kombinasi tanaman terhadap kondisi fisik tanah, serta pengaruh ruang tumbuh akar dan makrofauna tanah pada tumpangsari terhadap distribusi akar, erosi dan produksi biomassa.

Penelitian I merupakan percobaan lapangan pada petak berukuran 2,0 m x 1,2 m di Kiarapayung, Desa Cikeuyeup, Kecamatan Sukasari, Kabupaten Sumedang-Jawa Barat. Pendekatan dengan mengukur perubahan faktor fisik dan biologi pada permukaan dan di dalam tanah sebagai pengaruh pemberian bahan organik alang-alang dengan dosis yang berbeda. Hasil penelitian menunjukkan bahan organik alang-alang dapat meningkatkan kualitas tanah. Takaran 5,0 ton ha^{-1} merupakan takaran optimal yang dapat menurunkan bulk density 0,69 kali dan meningkatkan porositas 0,85 kali pada 8 MSA. Takaran tersebut juga meningkatkan status kesuburan tanah dari rendah menjadi sedang, menghasilkan peningkatan pH (0,18 kali), KTK (0,07 kali), KB (0,02 kali), karbon (0,21 kali), kalium (0,3 kali), kalsium (0,07 kali), magnesium (0,67 kali). Selain itu, menghasilkan kelimpahan Lumbricidae terbesar yaitu 256 individu m^{-2} pada VI MSA (meningkat sebesar 6,11 kali dibanding 0 MSA), dan meningkatkan keragaman makrofauna tanah (ditemukannya larva Carabidae, telur Lumbricidae, Termitidae, larva Phychodidae pada VI MSA).

Penelitian II merupakan percobaan lapangan pada plot erosi berukuran 11 m x 2 m dan secara semi lapangan pada kotak kayu berukuran 2,0 m x 1,2 m x 0,25 m dengan mengaplikasikan tujuh sistem tanam ("jagung+padi", "jagung+kacang tanah", "jagung+kacang merah", "ubi kayu+kacang tanah", "ubi kayu+kacang merah", "Ubi kayu+padi" dan "kacang merah" (monokultur)). Hasil penelitian menunjukkan perakaran pada tumpangsari jagung dan kacang merah mempunyai kemampuan penetrasi akar yang lebih besar dan dapat memperbaiki kondisi fisik tanah. Tumpangsari jagung dan kacang merah menghasilkan rasio biomassa akar halus dengan akar kecil paling mendekati seimbang (1,08), biomassa akar kecil yang lebih besar pada lapisan tanah (0-5) cm (68,22%), root length density akar kecil yang lebih panjang pada (0-5) cm (33,29 m m^{-3}), root length density akar halus pada (15-20) cm (115,72 m m^{-3}). Tumpangsari jagung dan kacang merah dapat meningkatkan kualitas tanah yaitu menurunkan bulk density 6,60 % dan menghasilkan

porositas tanah 65,40%. Perlakuan tersebut juga menghasilkan erosi terkecil yaitu 16,20 ton ha^{-1} dan berkontribusi menurunkan erosi 21,82 %, menghasilkan aliran permukaan paling kecil (4,70 m^3 ha^{-1}), infiltrasi paling besar (6003,83 m^3 ha^{-1}), faktor erodibilitas tanah (K) 0,097 (ton ha jam)(ha mj mm)$^{-1}$ dan menghasilkan kehilangan unsur hara paling kecil yaitu fosfat sebesar 27,20 ppm, kalium 0,30 me 100 g^{-1}, kalsium 3,48 me 100g^{-1} dan magnesium 1,13 me 100 g^{-1}.

Penelitian III merupakan percobaan lapangan pada petak erosi berukuran 8 m x 1,2 m. Aplikasi ruang tumbuh akar yang berbeda dilakukan dengan menanam jagung dan kacang merah dalam tumpangsari dengan kepadatan tanaman yang berbeda. Hasil penelitian menunjukkan kepadatan 20.000 rumpun jagung ha^{-1} (100 cm x 50 cm) + 62.500 rumpun kac. merah ha^{-1} (40 cm x 40 cm)+cacing tanah 10 individu m^{-2} (C4F2) merupakan perlakuan yang berpengaruh paling baik terhadap distribusi akar, kondisi fisik tanah dan erosi. Perlakuan C4F2 menghasilkan RAR akar halus paling besar pada kedalaman (15-20) cm sebesar 170,30 g m^{-3}. Perlakuan C4F2 juga menghasilkan erosi 9,22 ton ha^{-1} dan berkontribusi menurunkan erosi sebesar 4,21%, aliran permukaan terkecil (10,01 m^3 ha^{-1}), infiltrasi terbesar (1.589,86 m^3 ha^{-1}), resiko kehilangan unsur hara kalsium dan magnesium terkecil yaitu 0,92 serta berdasarkan erosi hasil pengukuran menghasilkan faktor pengelolaan tanaman (C) sebesar 0,40 dan faktor erodibilitas tanah (K) sebesar 0,0807 (ton ha jam)(ha mj mm)$^{-1}$. Perlakuan C4F2 juga menghasilkan biomassa tanaman sebesar 12,42 ton ha^{-1} dengan LER sebesar 1,69.

Tumpangsari tanaman dengan sistem perakaran berbeda disertai pemberian pupuk organik dan cacing tanah dapat menurunkan erosi, meningkatkan kualitas tanah dan meningkatkan produktivitas lahan kering.

Kata Kunci : aliran permukaan, bulk density, distribusi akar, erosi, tanaman semusim, tumpangsari

ABSTRACT

INTERCROPPING SYSTEM ON DRY LAND AGROECOSYSTEM AND ITS EFFECT ON EROSION

By

Aos
NIM : 30611014
(Doctoral Study Program of Biology)

Erosion can accelerate soil degradation in sloping dry land agroecosystem. Erosion control activities conducted with soil management by used organic matter and plant management by used intercropping system. Root interaction of annual crops in intercropping system and its effect on root distribution, soil quality, erosion and biomass production are critical in management of sloping dry land agroecosystem. Research objective were: (i) to examine the increasing of soil quality by applied local organic matter, (ii) to examine the effect of annual crops combination with different root system in intercropped on root distribution, soil quality, and erosion, (iii) to examine the effect of root growth space and soil macrofauna in intercropping on root distribution, erosion, and biomassa production. The research conducted in three stages were the increasing of soil quality by applied local organic matter, the effect of intercropping on erosion and root distribution on varied crop combination on soil physical condition, and the effect of root growth space and soil macrofauna in intercropping on root distribution, erosion, and biomass production.

The fisrt research conducted on field experiment and its conducted on plot of "2.0 m x 1.2 m" at Kiarapayung, Cikeuyeup Village, Sukasari Sub District, Sumedang District-West Java Province. Research approach with examined in changes of soil physical and soil biological as impact of varied organic matter dossage of cogon grass. The results showed that the organic matter increased in soil quality. The dossage of 5.0 ton ha^{-1} was optimal dossage and its decreased bulk density of 0.69 times and its increased soil porosity of 0.85 times at VIII weeks after aplikation (WAA). The dosis increased soil fertility status from low to medium level, resulted in increasing of soil acidity (0.18 times), exchangeable cation (0.07 times), base saturation (0.02 times), carbon (0.21 times), potassium (0.07 times), calsium (0.07 times), and magnesium (0.67 times). Furthermore, the treatment also resulted in the largest abundance of Lumbricidae (256 ind m^{-2}) and increased in diversity of soil macrofauna (Carabidae larvae, Lumbricidae eggs, Termitidae, and Phychodidae larvae foud in VI WWA).

The second research conducted on field experiment on plot erosion (11 m x 2 m) and on semi field experiment in wooden box (2 m x1.2 m x 0.25m) by applied of seven cropping systems ("maize+rice", "maize+peanut", maize+red bean", "cassava+peanut", "cassava+red bean", "cassava+rice" and "red bean" (monoculture)). The results showed that the rooting of "maize+red bean" combination had higher ability in root penetration and improved soil physical condition. The treatment also resulted in biomass ratio of fine to thin root was more closely equilibrium (1.08), the largest fine root biomass at soil depth layer (0-5) cm is 68.22%, the largest root length density of fine root at (0-5) cm and (15-20) cm are 33.29 m m^{-3} and 115.72 m m^{-3}

respectively. The intercropping of maize and red bean increased in soil quality (decreased in bulk density is 6.60 % and resulted in soil porosity is 65.40%). The treatment also resulted in the lowest erosion is 16.20 ton ha^{-1} and its contributed on erosion decreasing is 21.82 %, resulted in the lowest runoff is 4.70 m^3 ha^{-1}, resulted in the highest infiltration (6003.83 m^3 ha^{-1}), resulted in factor for soil erodibility (K) is 0,097 *(ton ha hour)(ha mj mm)$^{-1}$, and resulted in the lowest nutrien loss for phosphate 27.20 ppm, potassium 0.30 me 100g^{-1}, calsium 3.48 me 100 g^{-1} and magnesium 1.13 me 100 g^{-1}.*

The third research conducted on field experiment in plot erosion (8 m x1,2 m). The different space of root growth applied by planting the combination of maize and red bean with different planting density. The results showed that the plant density of 20,000 seeds ha^{-1} (100 cm x 50 cm)+red bean 62,500 seeds ha^{-1} (40 cm x 40 cm) accompanied by earthworms 10 ind m^{-2} (C4F2) resulted in the best effect on root distribution, soil physical condition, and erosion. The treatment of C4F2 resulted in erosion is 9.22 ton ha^{-1} and its contributed in erosion decreasing of 1.21%, decreased in the lowest runoff is 10.01 m^3 ha^{-1}), resulted in the highest of infiltration (1.589,86 m^3 ha^{-1}), *resulted in the lowest risk of nutrient loss of calcium and magnesium are 0.92, and resulted in crop management factor (C) is 0.40 and resulted in factor for soil erodibility (K) is 0,0807 (ton ha hour)(ha mj mm)$^{-1}$ and resulted in plant biomass is 12.42 to ha^{-1} with land equivalent ratio is 1.69.*

The intercropping with different root system accompanied by organic matter and soil macrofauna were decreased in erosion, increased in soil quality and dry land productivity.

Key words : *annual crop, bulk density, erosion, intercropping, root distribution, runoff*