Dampak aplikasi lumpur limbah industri sebagai pupuk pada tanaman = The impact of industrial waste sludge application as fertilizer on plant

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Abstrak

ABSTRAK
Limbah yang dalam persepsi manusia dipandang sebagai barang yang harus disingkirkan karena mengandung logam berat yang dapat membahayakan makhluk hidup, ternyata dalam beberapa hal masih dapat digunakan kembali (reuse) atau didaur-ulang (recycle). Dalam hal pemanfaatan limbah tersebut, beberapa penelitian terdahulu memberikan gambaran bahwa lumpur limbah sebagai hasil akhir dari suatu proses pengolahan limbah, dapat digunakan sebagai pupuk organik pada tanaman. Potensi tersebut perlu dimanfaatkan mengingat kuantitas jumlah limbah sebagai hasil sampingan dari suatu produk industri berkorelasi positif dengan kuantitas jumlah produk yang dihasilkan.

Di dalam upaya penanganan dan pengendalian limbah yang semakin lama semakin remit dan komplek, maka pemusatan industri dalam suatu lokasi dalam bentuk industrial estate, kawasan berikat, lahan peruntukan industri, perkampungan industri kecil, atau sentra industri merupakan langkah yang sangat strategis.

Berkaitan dengan upaya tersebut, maka keuntungan yang dapat diperoleh adalah bahaya adanya pencemaran lingkungan dapat diminimalisasi dan proses daur ulang (recycle) limbah yang masih mungkin dimanfaatkan kembali (reuse) untuk keperluan lain dapat dilakukan dengan efisien .

Berkaitan dengan hal tersebut di atas, maka percobaan ini bertujuan untuk mengamati pertumbuhan tanaman jagung yang diberi perlakuan pemupukan dengan lumpur limbah industri, menganalisis kandungan logam berat (Cr, Cd, Pb, dan Ni) yang diserap oleh tanaman selama fase pertumbuhan vegetatif dan generatif, dan menentukan tingkat dosis lumpur limbah industri sebagai pupuk organik yang optimal bagi tanaman.

Percobaan ini dilakukan di rumah kaca (green house) dengan menggunakan Rancangan Acak Lengkap (RAL) dengan 5 (lima) tingkatan dosis lumpur limbah industri ditambah kontrol (tanpa lumpur limbah industri), masing-masing ditambah tanah hingga mencapai total berat 5 kg. Setiap perlakuan diulang 3 (tiga) kali sehingga total jumlah sampel 18 kantong (polybag). Adapun tanaman yang dicobakan adalah tanaman jagung (Zea mays L.) varietas Pioner 5 (P5) yang peka terhadap pemupukan.

Hipotesis yang diuji pada penelitian ini adalah:
1. Penggunaan lumpur limbah industri sebagai pupuk pada tanaman berpengaruh positif terhadap pertumbuhan tanaman jagung yang dicobakan.
2. Pemupukan dengan lumpur limbah industri pada berbagai dosis akan memberikan respon yang berbeda terhadap semua parameter tumbuh fisiologis (tinggi tanaman, jumlah daun, berat kering batang, berat kering

daun, dan berat kering tongkol buah jagung) yang diteliti.
3. Terdapat perbedaan kandungan logam berat yang diserap oleh bagian tanaman (batang, daun, dan tongkol buah) jagung terhadap lumpur limbah yang diaplikasikan sebagai pupuk.

Adapun tingkat dosis campuran Lumpur limbah dan tanah yang digunakan adalah:
· LO = 5.000 gr tanah tanpa lumpur limbah (kontrol).
· L1 = 4.800 gr tanah + 200 gr lumpur limbah
· L2 = 4.600 gr tanah + 400 gr lumpur limbah
· L3 = 4.200 gr tanah + 800 gr lumpur limbah
· L4 = 3.400 gr tanah + 1.600 gr lumpur lirnbah.
· L5 =1.800 gr tanah +.3.200 gr lumpur limbah.

Data basil percobaan dianalisis dengan menggunakan metode statistik ANOVA (Analysis of Varians) dengan menggunakan SPSS for MS Window release 6.0 dan dilanjutkan dengan uji Bela Nyata Terkecil (BNT) atau Least Significant Difference (LSD). Sedang lumpur limbah industri yang digunakan serta jaringan organ tanaman dianalisis di laboratorium dengan menggunakan metode titrasi dan Atomic Absorption Spectrophotometer (AAS) untuk mengetahui kadar logam berat yang terlonggok

Bardasarkan hasil penelitian didapatkan kesimpulan:
1. Lumpur limbah PT. Kawasan Industri jababeka Cikarang dapat digunakan sebagai pupuk pada tanaman jagung. Hal itu dimungkinkan karena kandungan unsur hara mikro (Ca, Mg, Na, Fe, Cu, Zn, Mn, dan Co) dalam lumpur limbah industri itu cukup tinggi dan dapat diserap oleh tanaman untuk pertumbuhan vegetatif dan generatifnya. Pemanfaatanlumpur limbah sebagai pupuk dapat menguntungkan secara fisiologis bagi tanaman. Di samping itu, juga dapat memberi keuntungan dan segi lingkungan di mana kemungkinan pencemaran tanah dan air akibat lumpur limbah industri dapat dikontrol dengan baik.
2. Tanaman jagung yang dipupuk dengan lumpur limbah industri secara fisiologis menampakkan daun yang tegak dan keras. Batang tanaman kuat dan mempunyai ruas yang tinggi dan tegak. Kondisi seperti itu terjadi pada semua level dosis pemupukan yang dicobakan, kecuali pada tingkat dosis 3.200 gr lumpur limbah + 1.800 gr tanah (L5). Pada tingkat dosis dengan perlakuan LS, tanaman nampak kerdil dan kekar, ruas batang pendek-pendek sehingga daun berbentuk roset (bertumpuk-tumpuk).
3. Batas toleransi rnaksimal penggunaan lumpur limbah sebagai pupuk organik pada tanaman dari tingkat dosis yang dicobakan adalah 1.600 gr lumpur limbah dalam 3.400 gr tanah. Pemberian lumpur limbah melebihi dosis tersebut akan berpengaruh negatif pada tanaman. Pengaruh negatif yang ditimbulkan adalah tanaman menjadi kerdil dan sistem perakarannya jelek (akar tanaman pendek dan tidak memiliki bulu-bulu akar).
4. Dari hasil percobaan didapatkan tingkat dosis lumpur limbah yang optimal dan toleran untuk pertumbuhan tanaman adalah 400 gr lumpur limbah + 4.600 gr tanah (L2) dart 800 gr lumpur limbah + 4.200 gr tanah (L3). Hal tersebut ditunjukkan dengan tinggi tanaman, jumlah daun, berat kering batang dan berat kering daun yang nilai rata-ratanya relatif lebih tinggi dibanding perlakuan lainnya. Selain itu, sistem perakaran tanaman sangat baik.
5. Dibandingkan dengan potensinya, jagung jenis Hibrida varietas Pioner 5 (P5) yang dipupuk dengan lumpur limbah, menghasilkan organ tanaman (batang, daun dan tongkol buah) yang masih jauh dari potensi

hasilnya. Hal itu dikarenakan tingkat kesesuaian tanah (media) untuk pertanaman tergolong sedang dan unsur hara makro yang dibutuhkan tanaman relatif masih sangat minim dari kebutuhan yang seharusnya.

Berdasarkan kesimpulan di atas, maka untuk aplikasi lumpur limbah agar mendapatkan hasil pertanaman Jagung yang optimal, sebaiknya media tumbuh diberi tambahan unsur NPK karena kandungan unsur NPK dalam lumpur limbah industri tergolong relatif kedl dibanding untuk kebutuhan pertumbuhan dan produksi tanaman.

Akibat adanya komplikasi ekologis yang sering menyertai peningkatan basil produksi pertanian yang dipupuk dengan Sari Kering Limbah (SKL) industri, maka pada setiap dampak positif dari peningkatan produksi jangan pula dilupakan kemungkinan timbulnya hal-hal negatif. Oleh karena itu, pada setiap proyek pembangunan hendaknya perencanaan dan pengelolaan limbah hars dipikirkan sematang-matangnya.

Agar keamanan dari penggunaan Lumpur limbah dari kemungldnan bahaya keracunan atau pelonggokan logam berat melalui rantai makana.n, maka disarankan agar aplikasi limbah sebagai pupuk dilakukan pada tanaman nonpangan.

<hr><i>ABSTRACT
Man's perception on waste is that the material must be removed since it contains heavy metals that can endanger living creatures. However, it turned out that on several occasions it can be reused or recycled. In utilizing waste, several earlier studies showed that sludge as final product of waste processing could be used as organic fertilizer of plants. Such a potential need to be utilized considering the quantity of waste as a by product of an industrial product correlates positively with the quantity of product that is produced.

In an effort towards waste management and control which became increasingly difficult and complicated, hence, centralizing industry in one location in the form of industrial estate, bounded zone, area allocation for industry, small scale industry settlements or industrial centres constitute a very strategical step.

The benefits obtained related to such efforts include minimalization of environmental pollution and recycling of wastes that can still be utilized or reused for other purposes, can still be carried out efficiently.

This experiment then, has as objectives, to observe the growth of maize fertilized by industrial waste sludge, to analyze the heavy metals (Cr, Cd, Pb and Ni) contents absorbed by the plants during the vegetative and generative phases of growth and to decide the dosage of industrial waste sludge as optimal organic fertilizer for plants.

This experiment was carried out in a green house by using the Complete Random Design with 5 (five) different dosages of industrial waste sludge and additional control (without industrial waste sludge)_ Each specimen received additional soil so that a total weight of 5 kg. was achieved. Each were repeated 3 (three) times so that the total number of samples were 18 polybags. The plant used in the experiment is maize of the Pioner 5 (P5) variety that is sensitive towards fertilizers.

The hypothesis tested in this study were:

1. That industrial waste sludge has the chemical elements' composition that can be used as fertilizer to support the growth of plants. Has the waste sludge positive influence on the growth of maize?
2. Different dosages of industrial waste sludge resulted in different responses towards all parameters of physiological growth (height, total number of leaves, dry stem and leaves weigth, and dry corn stalk) under study.
3. The heavy metals' content that were absorbed by the different parts of the plant (stem, leaves, corn stalk) differ towards the waste sludge applied.

The dosages of waste sludge and soil mixtures used were as follows:
L0 = 5.000 gr soil without waste sludge(control)
L1 = 4.800 gr soil + 200 gr waste sludge
L2 = 4.600 gr soil + 400 gr waste sludge.
L3 = 4.200 gr soil + 800 gr waste sludge
L4 = 3.400 gr soil +1 .600 gr waste sludge.
L5 = 1.800 gr soil + 3.200 gr waste sludge.

Data of the experiment was analysed by using Analysis of Variance (ANOVA) with SFSS for MS Window release 6.0. It was then tested by the Least Significant Difference (LSD). Whereas the industrial waste sludge and plant organs' tissue were analized at the laboratory by using the titration method and Atomic Absorption Spectrophotometer (AAS) to know the heavy metal concentration.
Based on the study results, the following conclusions can be drawn:
1. The Cikarang Jababeka industry Zone PT. waste sludge can be used as fertilizer on maize plants. Such was made possible because the fertilizer micro elements' content (Ca, Mg, Na, Fe, Cu, Zn, Mn, and Co) of the industrial waste sludge is sufficiently complete and can be absorbed by the plants for vegetative and generative growths. However, the maximal limit of the dosage level experimented on was 1.600 gr of waste sludge in 3.400 gr soil. The provision of waste sludge exceeding the said dosage will negatively influence the plants. The negative influence took the form of bad roots' system and stunted growth.
2. Maize plants fertilized by industrial waste sludge showed physiologically hard and upright leaves, strong stems with high and upright nodes. Such condition took place for all levels of dosages experimented on, except at 3.200 gr dosage of waste sludge + 1.800 gr of soil (L5). At this dosage level, the plant dwarfs rigidly, the nodes were short so that the leaves took the form of rosettes.
3. The experimental results showed that the optimal and tolerant dosage levels were 400 gr of waste sludge + 4.600 gr of soil (L2) and 800 gr of waste sludge + 4.200 gr of soil (L3). In these cases, the height of the plant, the number of leaves and dry weights of stems and leaves have an average higher value compared with other dosage levels. In addition, the root system was also very good
4. Concentration of heavy metals in the waste sludge of waste processing result of Jababeka Industrial Zone FL is high enough. But if it is compared with the turn of heavy metals in compost fertilizer which is based on Environmental Protection Agency (EPA) standard, the contens of heavy metal Cr, Cd, Pb and Ni axe still below the allowed tolerancy limit.
5. Compared to its potential, Hibrid maize of Pioneer variety (P5) fertilized by waste sludge, produced plant organs (stem, leaves and corn stalk) which are far from its potential. Such was caused by the level of media suitability for plants of intermediate group and macro fertilizer elements needed by the plants are still

relatively very minimal than what is really needed.

Based on the above conclusions, therefore, to apply waste sludge in order to obtain optimal maize plants' production, the media should be given additional NPK elements. This is due to the minimal NPK contents in industrial waste sludge compared to the needs for growth and production of the plants in question.

For ecological complication often accompanies the increase of agriculture production result which is fertilized with industrial Waste Dry Essence, so do not forget the possibility of appearance of negative effects in every positive impact of production increase. Because of that in every development project the planning and processing of waste should be thought very seriously and widely.

For safety reasons and the possibility of poisioning or accumulation of heavy metals in the food chain, it is recommended that the application of waste sludge as fertilizer is carried out in non-food plants.;The Impact Of Industrial Waste Sludge Aplication As Fertilizer On PlantMan's perception on waste is that the material must be removed since it contains heavy metals that can endanger living creatures. However, it turned out that on several occasions it can be reused or recycled. In utilizing waste, several earlier studies showed that sludge as final product of waste processing could be used as organic fertilizer of plants. Such a potential need to be utilized considering the quantity of waste as a by product of an industrial product correlates positively with the quantity of product that is produced.

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