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Over-the-ground to establish biomass proportions in pea and vetch after treatment with natural manure

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Abstract— Some development parameters of pea (cv. Pleven 4) and vetch (cv. Obrazets 666) after treatment with natural manure were contemplated in a field preliminary completed at the Organization of Rummage Harvests, Pleven, Bulgaria. Humustim as natural compost was connected through presowing treatment of seeds, treatment during vegetation and blend between both, at various dosages. Proportions of over-the-ground weight to root framework weight, over-the-ground tallness to root framework length, just as explicit root length were resolved. It was discovered that the development factors of plants were decidedly impacted by natural manure. The over-the-ground weight to root framework weight proportions of pea ran from 4.80 to 6.29 and was higher than vetch. Over-the-ground tallness to establish framework length proportion in pea extended from 6.95 to 7.93, and in vetch from 5.30 to 7.39. The utilization of natural compost at the portion of 1.2 L/t and treatment during vegetation brought about better execution of root framework and explicit root length was 78.6 for pea and 84.3 for vetch.

Keywords— Above ground weight, Natural manure, Pea, Explicit root length, Vetch.

1. Introduction

Legumes have all around created root framework and through viable organic nitrogen obsession ingest from the air up to 70% from the nitrogen needs (Kretovich, 1997; Vance, 2001). Pea (Pisum sativum L.) and vetch (Vicia sativa L.) are important rummage vegetables with multifunctional job. Under good conditions they fixed to 150 kg N/ha and 45–70 kg N/ha aggregated in the dirt (Unkovich and Pate, 2000; Clayton et al., 2004; Voisin et al., 2013; Kusvuran et al., 2014). They have a short vegetation period and mineralization of root biomass happens quickly after gather (Jensen, 1994; Mihailovich et al., 2006). Pea can shape to 39.6 kg/day and vetch to 100 kg/day dry root biomass at the phase of blossoming (Sidorova et al., 2010; Kusvuran et al., 2014). Root biomass contains around 40% C, 18% of the root C for year falls in humus (Stylist, 1979; Kwabiah et al., 2005). In this way, they added to keep up and upgrade soil richness (Brady and Weil, 2002; Cupina et al., 2004; Pypers et al., 2007; Havlin et al., 2007; Nemecek et al., 2008; Ryabceva, 2009; Das, 2011; Kulak et al., 2013). The advancement of feasible horticulture with conservation nature is the principle vision of the system for reasonable improvement of farming. The point of this work was to think about some development parameters of pea and vetch, for example the proportions of over-the-ground weight to root framework weight, over-the-ground stature to root framework length, just as explicit root length after treatment with natural composts. The trial work was led on the test field of the Organization of Search Yields, Pleven, Bulgaria during 2002-2004.

2. MATERIALSAND METHODS

The preliminary was done under no water system and filtered chernozem soil subtype. Long plots strategy, 10 m2 were utilized in these experiemnts. The activity of natural compost Humustim (Sythesis of the fluid plan is appeared toward the finish of this section) was tried on spring search pea cv. Pleven 4 and vetch cv. Obrazets 666. They were planted at column separating 15 cm with a planting rate appraised at 110 (for pea) and 200 (for vetch) sprouted seeds/m2. The following variations in 4 replications were examined as: 1. Control – nontreated seeds; 2. One treatment during vegetation; 3. Two medicines during vegetation; 4. Treated seeds at the portion of 0.6 L/t seeds; 5. Treated seeds at the portion of 0.6 L/t seeds + one treatment during vegetation; 6. Treated seeds at the portion of 0.6 L/t seeds + two medications during vegetation; 7. Treated seeds at the portion of 1.2 L/t seeds; 8. Treated seeds at the portion of 1.2 L/t seeds + one treatment during vegetation; 9. Treated seeds at the portion of 1.2 L/t seeds + two medicines during vegetation. Seeds were dealt with 24 hours before planting. Treatment during vegetation was done at the phases of growing up and beginning blossoming to full blooming with the portion of compost 40 ml/da. Soil stone monuments (20/30/40 cm) were taken toward the start of blooming phase of vetch and foundations of 10 plants were washed (Beck et al., 1993). Over-the-ground stature (cm), root framework length (cm), over-the-ground weight (g/plant) (dried at 60 oC), root framework weight (g/plant) (dried at 60 oC) were recorded. Explicit root length was found as root length/root weight (cm/g). Trial information were measurably prepared utilizing SPSS PC program. Humustim is fluid natural humate manure and development trigger, a result of top-notch substrate with 100% more clean. It is an approved manure for use in natural creation. Creation of the fluid detailing of natural humate compost Humustim is as per the following: all out N – 3.0%; complete P – 0.4%; K – 9.7%; humic acids – 32.0%; fulvic acids – 4.0%; large scale components Ca, Mg, Zn, Cu, Co, Mb, B, S, and so on.; powder – 18.0%.

3. RESULTS AND DISCUSSION

Arrangement of biomass of the plants and its different organs is the consequence of the digestion movement of photosynthetic tissues, just as of the root framework working (Novikova, 2012). In pea 70% from the root mass is situated in the upper 15 cm of the dirt profile (Evans et al., 2001; Williams et al., 2013). In this investigation the treatment with natural manure influences the over-the-ground weight to root framework weight proportion of both, pea and vetch (Table 1). For instances, when two medicines during vegetation were connected the estimation of over-the-ground weight to root framework weight proportion was altogether lower as contrasted and the equivalent for one treatment. For the portion of Humustim 0.6 L/t + one and two vegetation medications the qualities were comparable, and the most ideal was this proportion for the portion of 1.2 L/t + two vegetation medicines. The distinctions for the variations with nontreated seeds were immaterial. For the portion of 1.2 L/t, analogically to pea, the most ideal was the over-the-ground weight to root framework weight proportion when two medicines during vegetation were performed. As indicated by Buyanovsky and Wagner, (1986) over-the-ground weight to establish framework weight proportion in pea is shut and remains moderately unaltered under various climatic conditions. Kwabiah et al., (2005) discovered over-the-ground weight to pull framework weight proportion for this harvest is 10.8. *Treatment during vegetation (TDV)

Table 1: Aboveground to root biomass ratios of pea and vetch after treatment with organic fertilizer

			Aboveground height/ root system length	
	pea	vetch	pea	vetch
Nontreated seeds	5.96	3.02	7.33	6.14
Nontreated seeds+one TDV*	5.25	2.99	7.38	6.71
Nontreated seeds + two TDV	4.80	3.02	7.10	5.92
Treated seeds 0.6 L/t	5.87	2.86	7.89	5.30
Treated seeds 0.6 L/t + one TDV	4.98	3.24	7.33	6.56
Treated seeds 0.6 L/t + two TDV	4.80	2.98	6.95	7.39
Treated seeds 1.2 L/t	6.29	3.06	7.93	5.48
Treated seeds 1.2 L/t + one TDV	5.95	3.20	7.74	6.02
Treated seeds 1.2 L/t + two TDV	5.71	2.86	7.27	5.97
SE (P=0.05)	0.18	0.04	0.11	0.21
Average	5.52	3.02	7.43	6.16
Min/max	4.80/6.29	2.86/3.24	6.95/7.93	5.30/7.39
SD	0.55	0.13	0.34	0.64

Fig. 1: Specific root length (cm/g) of pea and vetch after treatment with organic fertilizer

As a result of the enormous measure of root biomass in vetch the over-the-ground weight to root framework weight proportion was lower and run from 2.86 to 3.24. The present outcomes are in concurrence with Vollert et al., (2013). They found the qualities extending somewhere in the range of 1.18 and 2.41. The over-the-ground stature to establish framework length proportion in pea was the most positive for two medications during vegetation, portion of the compost 0.6 L/t + two medicines during vegetation, and 1.2 L/t + two medications during vegetation. With expanding the portions of natural compost for the variations with seeds treatment, the over-the-ground weight to root framework length proportion diminished because of the better advancement of root framework. Humic acids were incorporated into the arrangement of Humustim and they invigorate the development of plants root framework. Humic acids (%) were submitted with the exploratory dosages as pursues: with one treatment during vegetation – 12.8; with presowing treatment of seeds at the portion of 0.6 L/t seeds – 0.19; with presowing treatment of seeds at the portion of 1.2 L/t seeds – 0.38. A lot of root biomass framed after treatment with natural compost improved the likelihood for catch of certain supplements important for the better plant's advancement (Armstrong, 1999; Lambers et al., 2006; Magani and Kunchida, 2009; Datta et al., 2011). Above ground tallness to establish framework length proportion in vetch was positive when two vegetation medicines were connected and for the portions of 0.6 and 1.2 L/t of the manure. Coefficients of relationship between's the over-the-ground weight to root framework weight and over-the-ground stature to root framework length proportions were r= + 0.8034 for pea and r = + 0.2059 for vetch. The outcomes affirm with those of Naumkina, (2007). Explicit root length was lower when root arrangement of the plants was better created. For two medications with preparing during vegetation the particular root length was noteworthy lower (Fig. 1). The estimations of this trademark were close after treatment with Humustim at the portion of 0.6 L/t. The comparable was the propensity for vetch. Explicit root length was at the least level for the portion of 1.2 L/t + two vegetation medicines because of the more noteworthy load of root biomass. Coefficients of relationship between's particular root length and over-the-ground tallness to root framework length proportions were r = – 0.1904 for pea, and r = – 0.3951 for vetch.

4. Conclusion

Treatment with natural compost Humustim decidedly impacted the development factors in pea and vetch. The over-the-ground weight to root framework weight proportions of pea went from 4.80 to 6.29 and was higher than vetch (2.86 to 3.24). Over-the-ground tallness to establish framework length proportion in pea extended from 6.95 to 7.93, and in vetch from 5.30 to 7.39. The utilization of natural manure at the portion of 1.2 L/t and treatment during vegetation brought about better execution of root framework and explicit root length was 78.6 for pea and 84.3 for vetch.

5. References

[1] Adani, F.; Genevini, P.; Zaccheo, P.; Zocchi, G., (1998). The effect of commercial humic acid on tomato plant growth and mineral nutrition, J. Plant Nut., 21(31): 561-575 **(15 pages)**.

[2] Anonymous, (2014). Compost characteristics. http://composts for soil.com.au/images/pdf.

[3] Arancon, N.Q.; Edwards, C.A.; Lee, S.; Byrne, R., (2006). Effects of humic acids from vermicomposts on plant growth, Eur. J. Soil Biol., (42): 65-69 **(5 pages)**.

[4] Arya, S.; Toky, O.P.; Tomar, R.; Singh, L.; Hrris, P.J.C., (1993). Seasonal variation in auxin-induced rooting of Prosopis cineraria stem cuttings, The International Tree Crops J., (7): 249.

[5] Asing, J.; Wong, N.C.; Lau, S., (2004). Preliminary method development of humic acid extraction. Proceedings SOILS 2004, Innovation in soil science for sustainable agriculture, 13–14 April. 2004, (Zin, Z.Z. et al., eds.) p. 72–75. Serdang: UPM.

[6] Azam, F.; Malik, K.A., (1983). Effect of humic acid soaking of seeds on seedling growth of wheat (Triticum aestivum) under different conditions, Pakistan J. Bot., (15): 31-38 **(8 pages)**.

[7] Binner, E.; Smidt, E.; Tintner, J.; Bohm, K.; Lechner, P., (2011). How to enhance humification during composting of separately collected biowaste: impact of feedstock and processing, Waste Manage. Res., (29): 1153-1163 **(11 pages)**.

[8] Bonner, F.T.; McLemore, B.F.; Barnett, J.P., (1974). Presowing treatment of seed to speed germination, pp. 126-35 in 'Seeds of Woody Plants in the United States'. Agric. Handbook No. 450 Forest Service, Washington, D.C.

[9] Burt, R., (2004). Soil survey laboratory methods manual. United States Department of Agriculture, Natural Resources Conservation Service, Soil survey investigations report no 42, Version 4.0, Washington DC.

[10] Carter, M.R., (2002) Soil Quality for Sustainable Land Management, Agron. J., (94): 38-47 **(10 pages)**.

[11] Cavanagh, A.K., (1980). A review of some aspects of the germination of acacias, Proceeding Royal Society of Victoria, 91(1–2): 161–80 **(20 pages)**.

[12] Chen, Y.; De Nobili, M.; Aviad, T., (2004). Stimulatory effects of humic substances on plant growth. In Soil organic matter in sustainable agriculture. Magdoff F., Weil R. eds. (CRC Press, Boca Raton, FL, pp 131–165 **(35 pages)**.

[13] Crecchio, C.; Curci, M.; Mininni, R.; Ricciuti, P.; Ruggiero, P., (2001). Short-term effects of municipal solid waste compost amendments on soil carbon and nitrogen content, some enzyme activities and genetic diversity, Biol. Fertil. Soils., (34): 311-318 **(8 pages)**.

[14] Daldoum, D.M.A.; Ameeri, H.A., (2013). Growth performance of four acacia tree seedlings raised in silt soil amended with compost, JONARES, (1): 23-28 **(6 pages)**.

[15] Debosz, K.; Petersen, S.O.; Kure, L.K.; Ambus, P., (2002). Evaluating effects of sewage sludge and house hold compost on soil physical, chemical and microbiological properties, Appl. Soil Ecol., (19): 237-248 **(12 pages)**.

[16] EAD., (2009a). Soil survey of Abu Dhabi Emirate, vol I, Extensive survey, Environment Agency, Abu Dhabi, p xx+506.

[17] EAD., (2009b). Soil survey of Abu Dhabi Emirate, vol III, Intensive survey, Environment Agency, Abu Dhabi, p xviii+435.

[18] Edwards, C.A.; Lee, S.; Byrne, R., (2006). Effects of humic acids from vermicomposts on plant growth, Eur. J. Soil Biol., (46): 65-69 **(5 pages)**.

[19] Felbeck, G.T., (1965). Structural chemistry of soil humic substances, Adv. Agron., (17): 327-368 **(42 pages)**.

[20] Ferrara, G.; Pacifico, A.; Simeone, P.; Ferrara, E., (2007). Preliminary study on the effects of foliar applications of humic acids on 'Italia' table grape, http://www.oiv2007.hu/documents/ viticulture/140_ferrara_et_al_xxx_oiv_proceedings.pdf.

[21] Gretag Macbeth., (2000). Munsell Soil Color Charts. 617 Little Britain, New Windsor, NY 12553.

[22] Haider, K.; Martin, J.P., (1967). Synthesis and transformation of phenolic compounds by Epicoccum nigrum in relation to humic acid formation, Soil Sci. Soc. Am. Proc., (31): 766-772 **(7 pages)**.

[23] Haider, K.; Martin, J.P.; Rietz, E., (1977). Decomposition in soil of 14C-labelled coumaryl alcohols; free and lined into dehydropolymers and plant lignins and model humic acids, Soil Sci. Soc. Am. J., (41): 556-562 **(7 pages)**.

[24] Hargreaves, J.C.; Adl, M.S.; Warman, P.R.A., (2008). Review of the use of composted municipal solid waste in agriculture, Agr. Ecosystems Environ., (123):1-14 (14 pages).

[25] Katkat, A.V.; Celik, H.; Turan, M.A.; Asik, B.B., (2009). Effects of soil and foliar applications of humic substances on dry weight and mineral nutrients uptake of wheat under calcareous soil conditions, Aust. J. Basic Appl. Sci., 3(2): 1266-1273 **(8 pages)**.

[26] Kelting, M.; Harris, J.R.; Fanelli, J., (1998). Humate-based biostimulants affect early post-transplant root growth and sapflow of balled and burlapped red maple, Horticultural Sci., (33): 819-822 **(4 pages)**.

[27] Khang, V.T., (2011). Fulvic foliar ertilizer impact on growth of rice and radish at first stage, Omonrice, (18): 144-148 **(5 pages)**.

[28] KISR., (1999). Soil survey for the state of Kuwait, vol II, Reconnaissance survey. AACM International, Adelaide.

[29] Ladd, J.N.; Butler, J.H.A., (1971). Inhibition and stimulation of proteolytic enzyme activities by soil humic acids, Aust. J. Soil Res., (7): 253-261 **(9 pages)**.

[30] Lee, Y.S.; Bartlett, R.J., (1976). Stimulation of plant growth by humic substances, Soil Sci. Soc. Am. J., (40): 876-879 **(4 pages)**.

[31] Leifeld, J.; Siebert, S.; Kögel-Knabner, I., (2001). Stabilization of composted organic matter after application to a humus-free sandy mining soil, J. Environ. Qual., (30): 602-607 **(6 pages)**.

[32] MAF., (1990). General soil map of the Sultanate of Oman. Ministry of Agriculture and Fisheries, Directorate General of Agricultural Research, Muscat.

[33] Malcolm, R.E.; Vaughan, D., (1979a). Comparative effects of soil organic matter fractions on phosphatase activities in wheat roots, Plant Soil, (51): 117-126 **(10 pages)**.

[34] Malcolm, R.E.; Vaughan, D., (1979b). Effects of humic acid fractions on invertase activities in plant tissues, Soil Biol. Biochem., (11): 65-72 **(8 pages)**.

[35] Malik, K.A.; Azam, F., (1984). Effect of humic acid on wheat (Triticum aestivum L.) seedling growth, Environ. Experimental Bot., (25): 245-252 **(8 pages)**.

[36] Malik, S.; Mann, S.; Gupta, D.; Gupta, R.K., (2013). Nutraceutical Properties of Prosopis cineraria (L.) Druce Pods: A Component of “Panchkuta”, Pharmacognosy Phytochem., (2): 66-73 **(8 pages)**.

[38] Martin, J.P.; Haider, K., (1971). Microbial activity in relation to soil humus formation, Soil Sci., (111): 54-63 **(10 pages)**.

[39] MAW., (1985). General soil map of Kingdom of Saudi Arabia, Ministry of Agriculture and Water, Riyadh, Saudi Arabia.

[40] Mayhew, L., (2004). Humic substances in biological agricultural systems, Acres 34.

[41] Merlol., R.; Ghisil, N.R.; Passeral, C., (1991). Effects of humic substances on carbohydrate metabolism of maize leaves, Canadian J. Plant Sci., (71): 419-425 **(7 pages)**.

[42] MMAA., (2005). Soil classification and land use specifications for the State of Qatar. Phase IV: The atlas of soils for the State of Qatar, Ministry of Municipal Affairs and Agriculture, Qatar.

[43] Mohammadi, K.; Ghalavand, A.; Aghaalikhani, M.; Heidari, G.R.; Shahmoradi, B.; Sohrabi, Y., (2011). Effect of different methods of crop rotation and fertilization on canola traits and soil microbial activity, Aust. J. Crop Sci., (5): 1261–1268 **(8 pages)**.

[44] Muscolo, A.; Cutrupi, S.; Nardi, S., (1998). IAA detection in humic substances, Soil Biol. Biochem., (30): 1190-1201 **(12 pages)**.

[45] Nardi, S.; Pizzeghello, D.; Gessa, C.; Ferrarese, L.; Trainotti, L.; Casadoro, G., (2000). A low molecular weight humic fraction on nitrate uptake and protein synthesis in maize seedlings, Soil Biol. Biochem., (32): 415-419 **(5 pages)**.

[46] Omar, S.A.S.; Shahid, S.A., (2013). Reconnaissance soil survey for the State of Kuwait. Chapter 3, In: Developments in Soil Classification, Land Use Planning and Policy Implications- Innovative Thinking of Soil Inventory for Land Use Planning and Management of Land Resources (Shahid S.A. Taha, F.K. Abdelfattah, M.A. (eds). Pp. 85-107 **(23 pages)**.

[47] Patil, R., (2011). Effect of potassium humate and deproteinised Juice (DPJ) on seed germination and seedling growth of wheat and jowar, Annals Biol. Res. (2): 26-29 **(4 pages)**.

[48] Piccolo, A.; Celano, G.; Pietramellara, G., (1993). Effects of fractions of coal-derived humic substances on seed germination and growth of seedlings (Lactuga sativa and Lycopersicum esculentum), Biology and Fertility of Soils, (16): 11-15 **(5 pages)**.

[49] Piccolo, A.; Pietramellara, G.; Mbagwu, J.D.C., (1997). Reduction in soil loss from erosion-susceptible soils amended with humic substances from oxidized coal, Soil Tech., (10): 235-245 **(11 pages)**.

[50] Rauthan, B.S.; Schnitzer, M., (1981). Effect of a soil fulvic acid on the growth and nutrient content of cucumber (Cucumis sativus), Plant Soil, (63): 491-495 **(5 pages)**.

[51] Reynolds, A.G.; Wardle, D.A.; Drought, B.; Cantwell, R., (1995). Gro-Mate soil amendment improves growth of greenhouse-grown “Chardonnay” grapevines, Horticultural Sci., (30): 539-542 **(4 pages)**.

[52] Rivero, C.; Chirenjeb, T.; Ma, L.Q.; Martinez, G., (2004). Influence of compost on soil organic matter quality under tropical conditions, Geoderma., (123): 355-361 **(7 pages)**.

[53] Narayanan, N.; Nargis, N.R.R., (2012). Toxicity evaluation on hydroalcoholic extract of leaf and stem bark of Prosopis cineraria, In. J. Pharmacy Pharmaceutical Sci., (4): 113-118 **(5 pages)**.

[54] Sanchez-Monedero, M.A.; Paredes, R.A.C.; Bernal, M.P., (2001). Nirrogen transformation during composting by the Rutgers system and its effects on pH, EC and maturity of the composting mixtures, Bioresource Tech., (78): 301-308 **(8 pages)**.

[55] Scheibert, C.; Stietiya, M.H.; Sommer, J.; Abdalla, O.E.S.; Schramm, H.; Memah, A. M., (2005). The atlas of soils for the State of Qatar, Ministry of Municipal Affairs and Agriculture, Doha.

[56] Schnitzer, M.; Poapst, P.A., (1967). Effects of a soil humic compound on root initiation, Nature, (213): 598-599 **(2 pages)**.

[57] Shahid, S.A., (2014). The ICBA educational landscape design philosophy, Landscape, 30-33 **(4 pages)**.

[58] Shahid, S.A.; Abdelfattah, M.A.; Wilson, M.A.; Kelley J.A.; Chiaretti, J.V., (Eds.). (2014). United Arab Emirates Keys to Soil Taxnomy. Springer pp. xxii+108.

[59] Shahid, S.A.; Abdelfattah, M.A., (2008). Soils of Abu Dhabi Emirate. In: Perry RJ (Eed.) Terrestrial environment of Abu Dhabi Emirate, Environment Agency, Abu Dhabi, pp 71–91 **(21 pages)**.

[60] Smidova, M., (1962) Effect of sodium humate on swelling and germination of plant roots, Biol. Plant, (4): 112-118 **(7 pages)**.

[61] Stamatiadis, S.; Doran, J.W.; Kettler, T., (1999). Field and laboratory evaluation of soil quality changes resulting from injection of liquid sewage sludge, Appl. Soil Ecol., (12): 263–272 **(10 pages)**.

[62] Tester, C.F., (1990). Organic amendment effects on physical and chemical properties of a sandy soil, Soil Sci. Soc. Am. J., (54): 827-883 **(57 pages)**.

[63] Trevisan, S.; Francisco, O.; Quaggiotti, S.; Nardi, S., (2010). Humic substances biological activity at the plant-soil interface - From environmental aspects to molecular factors, Plant Sig. Behave., (5): 635-643 **(9 pages)**.

[64] Vaughan, D.; Malcom, R.E., (1985). Influence of humic substances on growth and physiological processes. In: Vaughan, D., Malcom, R.E.(Eds.), Soil Organic Matter and Biological Activity, Martinus Nijhoff/Junk W, Dordrecht, The Netherlands, pp. 37–76 **(40 pages)**.

[65] Vaughan, D.; Malcolm, R.E., (1979). Effect of soil organic matter on peroxidase activity of wheat roots, Soil Biol. Biochem., (11): 57-63 **(7 pages)**.

[66] Vaughan, D.; Linehan, D.J., (2004). The growth of wheat plants in humic acid solutions under axenic conditions, Plants Soil, (44): 445-449 **(5 pages)**.

[67] Wang, I.X.J.; Wang, Z.Q.; Li, S.G., (1995). The effect of humic acids on the availability of phosphorus fertilizers in alkaline soils, Soil Use Manage., (11): 99-102 **(4 pages)**.

[68] Werner, M.R., (1997). Soil quality characteristics during conversion to organic orchard management, Appl. Soil Ecol., (5): 151-167 **(17 pages)**.

[69] Wortmann, C.S.; Shapiro, C.A., (2008). The effects of manure application on soil aggregation, Nutr. Cycl. Agroecosyst., (80): 173–180 **(15 pages)**.

[70] Youngs, R.W.; Frost, C.M., (1963). Humic acids from leonardite, a soil conditioner and organic fertilizer. 967 American Chemical Society, Division of Fuel Chemistry (7): 12-17 **(6 pages)**.