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Response of Different Levels of Inorganic Fertilizer, Organic Manure and Bio-Fertilizer on Physico-chemical Properties of Soil in Pea (*Pisum Sativum* L.) Var. Kashi Ageti

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A B S T R A C T

A field study was conducted on the Response of different Levels of inorganic fertilizer, organic manure and Bio-fertilizer on Physico-chemical properties of soil in Pea (*Pisum sativum* L.) Var. Kashi Ageti at the Soil Science and Agricultural Chemistry Research Farm, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj during *Rabi* season 2019-20. The soil of experimental area falls in order *Inceptisol* and soil texture was sandy loam. The result showed that in treatment T_9[@ 100 % (NPK + Zn) + @ 50% FYM + @ 50% *Azotobacter*], bulk density 1.52 Mg m^{-3}, particle density 2.56 Mg m^{-3}, pore space 46.87 %, water holding capacity 39.62 %, pH 7.38, EC 0.62 (dSm^{-1}), organic carbon 0.72 %, available nitrogen 332.45 kg ha^{-1}, available phosphorus 35.75 kg ha^{-1}, available potassium 219.54 kg ha^{-1} and zinc 0.62 ppm as compared to T_1 (control).

Introduction

Pea is an important *Rabi* leguminous crop grown in Indian subcontinent. It is one of the main sources of dietary protein for the majority of Indians. The productivity is 1356 $kgha^{-1}$. Moreover, its high yield potential3.5 t ha^{-1} through balanced fertilization envisages ample scope to increase its yields further (Anonymous 2009). It is one of the important vegetables in the world and ranks among the top 10 vegetable crops and are highly nutritive and contain a high percentage of digestible 22.5% proteins, 58.5% carbohydrates, 1.0% fats, 4.4% fibers and 3% minerals vitamins, particularly of the B group. Pea is commonly used in human diet throughout the world and it is rich in protein 21-25 %, carbohydrates, vitamin A and C, Ca, phosphorous and has high levels of amino acids lysin and tryptophan. Biofertilizers are known to play an important role in increasing availability of nitrogen and phosphorus besides improving biological fixation of

atmospheric nitrogen and enhance phosphorus availability to crop and hold a great promise to improve crop yields through better nutrient supplies (Bhat *et al.,* 2013). Cultivation maintains soil fertility through biological nitrogen fixation in association with symbiotic rhizobium prevalent in its root nodules and thus play a vital role in fostering sustainable agriculture (Negi *et al.,* 2006).Application of NPK to pea crop usually promotes vegetative growth and nodulation (Vorob, 2000), and improves green pod yield (Kanaujia *et al.,* 1998). FYM is known to play an important role in improving the fertility and productivity of soils through its positive effects on soil physical, chemical and biological properties and balanced plant nutrition (Kumar *et al.,* 2011). It improves the structure and water holding capacity of soil and increases the availability of added inorganic nutrients resulting in the positive effect on the photosynthetic surface, there by improved the yield (Byra *et al*., 2008).

Materials and Methods

The pea variety Kashi Ageti released from Indian Institute of Vegetable Research (IIVR), Varanasi was crossed with multi-flowering genotypes viz., VRP-500 (triple flowers) and VRPM-901(triple flowers). It is an early maturing variety bears 9-10 pods plant^{-1} and pods are 9 -10 cm long bears 8-9 numbers of seeds and average pod weight is 9-10 g. Seed to seed duration is 95-100 days however, picking starts from 60-63 days after sowing. Pod yield is 95- 105 q/ha. Shelling % is 48.5 to 50. Variety is tolerant to leaf minor & pod borer recommended for release and cultivation in the states of Uttar Pradesh, Punjab, Bihar and Jharkhand. Sowing time of this variety 25th October to 20th November is suitable and average seed rate is 140-150kgha^{-1}. Nitrogen requirement 40-50 kg N, 70-80 kg each of P_2O_5 and K_2O is sufficient for one hectare. Best Soil type for this variety is Sandy loam.

Soil analysis

Soil samples were taken from 0-15 cm soil depth randomly prior to tillage operations, air dried and passed through 2mm sieve. Then the composite soil sample was taken for physical and chemical analysis. The physical analysis was done with the help of Bouyoucos hydrometer method (Bouyoucos 1927) for textural class and graduated measuring cylinder (Muthuval *et al.,* 1992) for bulk and particle density. The chemical analysis of soil was done through various methods *i.e.* pH by digital pH meter (Jackson, 1958), EC by digital EC meter (Wilcox, 1950), available nitrogen by wet oxidation method (Walkley and Black, 1947), phosphorus by modified alkaline permanganate oxidation method (Subbiah and Asija, 1956), potassium by spectrophotometric method (Olsen *et al.,* 1954) and organic carbon (%) by flame photometric method (Toth and Prince, 1949). The texture was found sandy loam according to texture triangle USDA system. The soil of experimental area falls in order of *Inceptisol*.

Treatment combination

Experiment was laid out in randomized block design with three levels of inorganic fertilizer, organic manure and bio-fertilizer. Plot size was 2 x 2 m^2 for crop seed rate is 150-160 kg ha^{-1}. In the present study, nine treatments were formulated in table 1.

Results and Discussion

Physical properties of soil after crop harvested in pea crop

As depicted in table 2 and fig. 1 clearly shows the response of bulk density, particle density, pore space, water holding capacity of soil was recorded as influenced by different levels of inorganic fertilizer, organic manure, and bio fertilizer.

Table.1 Treatment combination of pea

Treatment	Treatment Combination
T_1 (I_0+OB_0)	Absolute Control
T_2 (I_0+OB_1)	@ 0 % (NPK +Zn) + @25% FYM + @25% *Azotobacter*
T_3 (I_0+OB_2)	@ 0 % (NPK + Zn) + @ 50% FYM + @ 50% *Azotobacter*
T_4 (I_1+OB_0)	@ 50 % (NPK + Zn) + @ 0% FYM + @ 0% *Azotobacter*
T_5 (I_1+OB_1)	@ 50 % (NPK + Zn) + @ 25% FYM + @ 25% *Azotobacter*
T_6 (I_1+OB_2)	@ 50 % (NPK + Zn) + @ 50% FYM + @ 50% @ *Azotobacter*
T_7 (I_3+OB_0)	@ 100 % (NPK + Zn) + @ 0% FYM + @ 0% *Azotobacter*
T_8 (I_3+OB_1)	@ 100 % (NPK + Zn) + @ 25% FYM + @ 25% *Azotobacter*
T_9 (I_3+OB_2)	@ 100 % (NPK + Zn) + @ 50% FYM + @ 50% *Azotobacter*

Table.2 Effect of different levels of inorganic fertilizer, organic manure and bio fertilizer on physical parameters of soil in pea

Treatment	Bulk density (Mgm^{-3})	Particle density (Mgm^{-3})	Pore space (%)	Water holding capacity (%)
T_1	1.20	2.26	38.32	30.57
T_2	1.26	2.30	40.62	32.18
T_3	1.32	2.35	41.85	33.42
T_4	1.28	2.32	39.44	31.89
T_5	1.36	2.38	42.50	35.72
T_6	1.42	2.44	44.56	37.29
T_7	1.39	2.40	43.28	36.82
T_8	1.45	2.49	45.49	38.42
T_9	1.52	2.56	46.87	39.62
F- test	NS	S	S	S
S. Ed. (+)	1.49	0.11	0.74	0.74
C.D. (P= 0.05)	0.72	0.05	0.36	0.36

Table.3 Effect of different levels of inorganic fertilizer, organic manure and bio fertilizer on chemical parameters of soil in pea

Treatment	pH (1:2) w/v	EC ($dS\ m^{-1}$)	Organic carbon (%)	Nitrogen ($kg\ ha^{-1}$)	Phosphorus ($kg\ ha^{-1}$)	Potassium ($kg\ ha^{-1}$)	Zinc (ppm)
T_1	6.5	0.32	0.55	310.18	25.62	195.42	0.52
T_2	6.56	0.38	0.58	315.2	27.18	198.72	0.54
T_3	6.62	0.42	0.6	318.51	29.52	201.62	0.56
T_4	6.58	0.36	0.56	316.72	26.61	197.75	0.55
T_5	6.88	0.45	0.64	320.54	28.72	203.28	0.57
T_6	7.02	0.47	0.66	325.88	30.54	208.45	0.59
T_7	7.16	0.52	0.65	323.72	31.29	210.86	0.58
T_8	7.29	0.58	0.68	328.29	32.16	215.78	0.60
T_9	7.38	0.62	0.72	332.45	35.75	219.54	0.62
F- test	NS	S	S	S	S	S	S
S. Ed (+)	1.32	0.10	0.10	8.72	2.03	4.12	0.019
C.D. (P= 0.05)	0.63	0.04	0.04	4.20	0.98	1.99	0.009

Fig.1 Effect of different level of inorganic fertilizer, organic manure and bio fertilizer on physical parameters of soil in pea

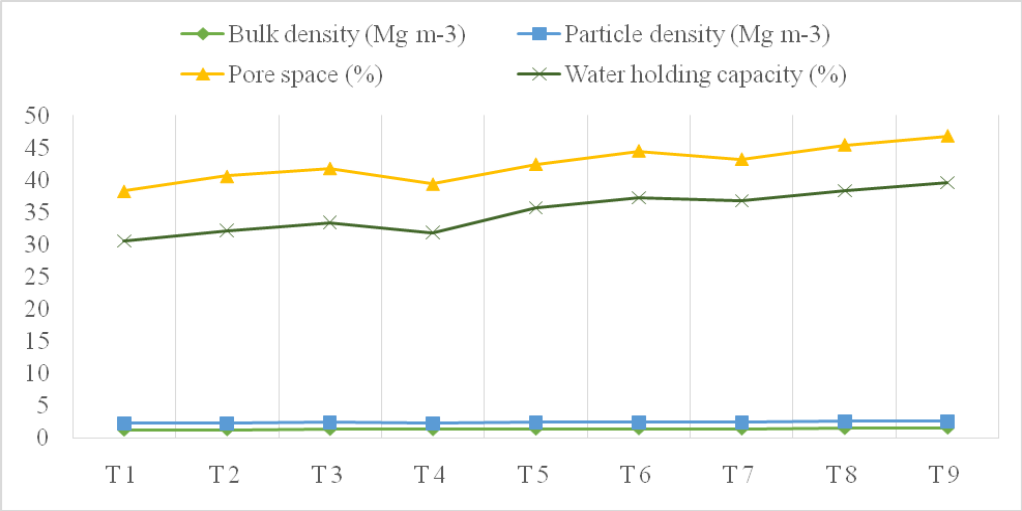
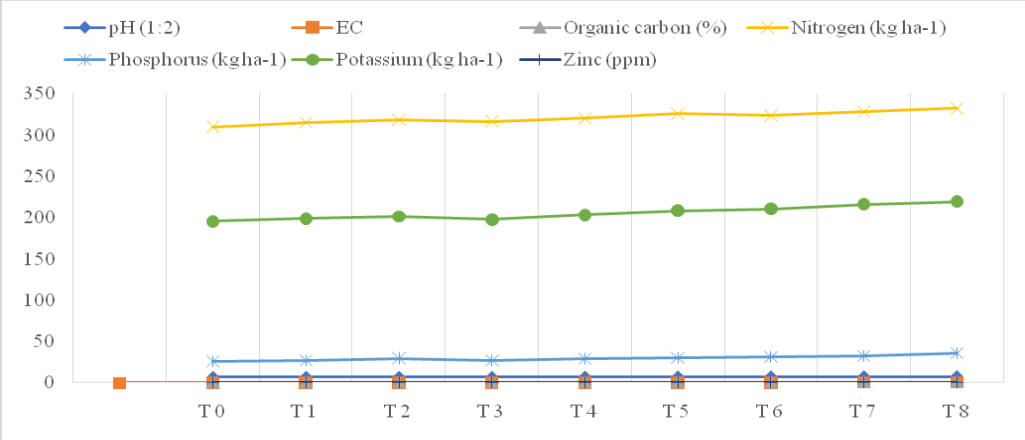


Fig.2 Effect of different levels of inorganic fertilizer, organic manure and bio fertilizer on chemical parameters of soil in pea



The maximum bulk density of soil was recorded 1.52 Mg m^{-3} in T_9[@ 100 % (NPK + Zn) + 50% FYM + 50% Azotobacter] followed by 1.45 Mg m^{-3} in T_8 [@ 100 % (NPK + Zn) + 25% FYM + 25% Azotobacter] and 1.42 Mg m^{-3} in T_6 [@ 50 % (NPK + Zn) + 50% FYM + 50% *Azotobacter*] and the minimum bulk density of soil was recorded 1.20 Mg m^{-3} in T_1 (control) respectively. The mean value of bulk density of soil (Mg m^{-3}) was found non-significant. Theparticle densityof soil was recorded as influenced by different levels of inorganic fertilizer, organic manure, and bio fertilizer. The maximum particle density of soil was recorded 2.56 Mg m^{-3} in T_9[@ 100 % (NPK + Zn) + 50% FYM + 50% *Azotobacter*] followed by 2.49 Mg m^{-3} in T_8[@ 100 % (NPK + Zn) + 25% FYM + 25% *Azotobacter*] and 2.44 Mg m^{-3} in T_6 [@ 50 % (NPK + Zn) + 50% FYM + 50% *Azotobacter*] and the minimum particle density of soil was recorded 2.26 Mg m^{-3} in T_1 (control) respectively. The mean value of particle density of soil (Mg m^{-3}) was found significant. The maximum pore space of soil was recorded 46.87 %in T_9 [@ 100 % (NPK +

Zn) + 50% FYM + 50% *Azotobacter*] followed by 45.49 %in T_8[@ 100 % (NPK + Zn) + 25% FYM + 25% *Azotobacter*] and 44.56 %in T_6[@ 50 % (NPK + Zn) + 50% FYM + 50% *Azotobacter*] and the minimum pore space of soil was recorded 38.32 %in T_1 (control) respectively. The mean value of pore spaceof soil (%) was found significant. The maximum water holding capacity of soil was recorded 39.62 %in T_9[@ 100 % (NPK + Zn) + 50% FYM + 50% *Azotobacter*] followed by 38.42 %in T_8[@ 100 % (NPK + Zn) + 25% FYM + 25% Azotobacter] and 37.29 %in T_6 [@ 50 % (NPK + Zn) + 50% FYM + 50% *Azotobacter*] and the minimum water holding capacity of soil was recorded 30.57 %in T_1 (control) respectively. The mean value of water holding capacity (%) of soil was found significant. Same result of bulk density, particle density, pore space, water holding capacityof soilalso found by (Toppo *et al.*, 2017; Chethan *et al.*, 2018).

Chemical properties of soil after crop harvested in pea crop

The result of data depicted table 3 and fig. 2 clearly shows the response of pH, EC, organic carbon, nitrogen, phosphorus, potassium, zincof soil was recorded as influenced by different levels of inorganic fertilizer, organic manure, and bio fertilizer. The maximum pH of soil was recorded 7.38 in T_9[@ 100 % (NPK + Zn) + 50% FYM + 50% Azotobacter] followed by 7.29 in T_8[@ 100 % (NPK + Zn) + 25% FYM + 25% *Azotobacter*] and 7.16in T_7[@ 100 % (NPK + Zn) + 0% FYM + 0% *Azotobacter*]and the minimum pHof soil was recorded 6.50 in T_1 (control) respectively. The mean value of soil pH was found non-significant.The maximum electrical conductivity (EC) of soil was recorded 0.62 dS m^{-1}in T_9[@ 100 % (NPK + Zn) + 50% FYM + 50% *Azotobacter*] followed by 0.58 dS m^{-1}in T_8[@ 100 % (NPK + Zn) + 25% FYM + 25% *Azotobacter*] and 0.52 dS m^{-1} in T_7[@ 100 % (NPK + Zn) + 0% FYM + 0% *Azotobacter*]and the minimum electrical conductivityof soil was recorded 0.32 dS m^{-1} in T_1 (control) respectively. The mean value of soil electrical conductivity was found significant. The maximum organic carbon of soil was recorded 0.72 %in T_9 [@ 100 % (NPK + Zn) + 50% FYM + 50% *Azotobacter*] followed by 0.68 %in T_8[@ 100 % (NPK + Zn) + 25% FYM + 25% *Azotobacter*] and 0.66 %in T_6[@ 50 % (NPK + Zn) + 50% FYM + 50% *Azotobacter*] and the minimum organic carbon of soil was recorded 0.55 %in T_1 (control) respectively. The mean value of soil organic carbon was found significant. Same result ofpH, EC, organic carbon also found by (Gabr *et al.*, 2011). The maximum available nitrogenof soil was recorded 332.45 kg ha^{-1}in T_9[@ 100 % (NPK + Zn) + 50% FYM + 50% Azotobacter)] followed by 328.29 kg ha^{-1}in T_8[@ 100 % (NPK + Zn) + 25% FYM + 25% Azotobacter] and 325.88 kg ha^{-1} in T_6[@ 50 % (NPK + Zn) + 50% FYM + 50% Azotobacter]and the minimum available nitrogenof soil was recorded 310.18 kg ha^{-1} in T_1 (control) respectively. The mean value of available nitrogen of soil was found significant. The maximum available phosphorusof soil was recorded 35.75kg ha^{-1}in T_9[@ 100 % (NPK + Zn) + 50% FYM + 50% *Azotobacter*] followed by 32.16 kg ha^{-1}in T_8[@ 100 % (NPK + Zn) + 25% FYM + 25% *Azotobacter*] and 31.29 kg ha^{-1} in T_7[@ 100 % (NPK + Zn) + 0% FYM + 0% *Azotobacter*] and the minimum available phosphorusof soil was recorded 25.62 kg ha^{-1} in T_1 (control) respectively. The mean value of available phosphorus of soil was found significant. The maximum available potassiumof soil was recorded 219.54 kg ha^{-1}in T_9[@ 100 % (NPK + Zn) + 50% FYM + 50% *Azotobacter*] followed by 215.78 kg ha^{-1}in T_8[@ 100 % (NPK + Zn) + 25% FYM + 25% *Azotobacter*] and 210.86 kg ha^{-1} in T_7[@ 100 % (NPK + Zn) + 0% FYM + 0% *Azotobacter*] and the minimum available potassiumof soil was

recorded 195.42 kg ha^{-1} in T_1 (control) respectively. The mean value of available potassium of soil was found significant. Same result nitrogen, phosphorus, potassium also found by Karahne *et al.,* (2009) and Gopinath *et al.,* (2009). The maximum available zinc of soil was recorded 0.62 ppm in T_9[@ 100 % (NPK + Zn) + 50% FYM + 50% *Azotobacter*] followed by 0.60 ppm in T_8 (@ 100 % (NPK + Zn) + 25% FYM + 25% *Azotobacter*) and 0.59 ppmin T_6[@ 50 % (NPK + Zn) + 50% FYM + 50% *Azotobacter*] and the minimum available zinc of soil was recorded 0.52 ppmin T_1 (control) respectively. The mean value of available zinc of soil was found significant. Same result of zinc also found by Singh *et al.,* (2015) and Chethan *et al.,* (2018).

It was concluded from trail that the application of inorganic fertilizer, organic manure, and bio fertilizer in treatment T_9[@ 100 % (NPK +Zn) + @50% FYM + @50% *Azotobacter*] was found to be the best in terms of soil properties *i.e.* bulk density, particle density, % pore space, water holding capacity, EC, pH, organic carbon, available NPK and Fe than any other treatment combinations. Since the result is based on one season experimrent, further trail is needed to substantiate the results. Thus it can be concluded that different levels of inorganic fertilizer, organic manure, and bio fertilizer improved soil nutrient and increased productivity and fertility of soil and sustain soil heath.

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References

Anonymous (2009) FAOSTAT, Production. Cited February 12, 2008, 33: S141–S145.

Bhat, T.A., Gupta, M., Ganai, M.A., Ahanger, R.A. and Bhat, H.A. (2013) Yield, Soil Health and Nutrient Utilization of Field Pea (*Pisum sativum* L.) as Affected by Phosphorus and Biofertilizers under Subtropical Conditions of Jammu. *International Journal of Modern Plant and Animal Science*. 1 (1): 1-8.

Bouyoucos, G. J. (1927) The hydrometer as a new method for the mechanical analysis of soils. *Soil Science*.23: 343-353.

Byra, R. K., Uppar, B.S., Vyakaranahal, B.S., Hiremath, S.M., Ravihunje and Nadaf, H.L. (2008) Effect of integrated nutrient management on sunflower hybrid (KBSH-1) seed production. *Karnataka Journal of Agriculture Sciences*. 21 (2): 171-175.

Chethan, K. V., David, A. A., Thomas, T., Swaroop, N., Rao S. and Hassan, A. (2018) Effect of different levels of N P K and Zn on physico-chemical properties of soil growth parameters and yield by pea (*Pisum sativum* L.) Cv. Rachana. *Journal of Pharmacognosy and Phytochemistry*. 7 (3): 2212-2215.

Gabr, S. M., Elkhatib, H. A. and El-Keriawy, A. M. (2007) Effect of Different Biofertilizer Types and Nitrogen Fertilizer Levels on Growth, Yield and Chemical Contents of Pea Plants (*Pisum Sativum* L.). *J. Agric. & Env. Sci. Alex. Univ.,Egypt*, 6(2): 192- 218.

Gopinath, K. A., Saha, S., Mina, B. L., Pande, H., Kumar, N., Srivastava, A. K. and Gupta, H. S. (2009) Yield potential of garden pea (*Pisum sativum* L.) varieties, and soil properties under organic and integrated nutrient management systems. *Archives of Agronomy and Soil Science*, 55(2): 157–167.

Jackson, M. L. (1958) *Soil chemical analysis Prentice Hall of India Ltd*. New Delhi.

219-221.

Kanaujia, S.P., Sharma, S. K. and Rastogi, K. B. (1998) Effect of phosphorus, potassium and Rhizobium inoculation on growth and yield of pea (*Pisum sativum* L.). *Ann. Agric. Res.*, 19: 219-221.

Karahne, V. and Singh, V. P. (2009) Effect of rhizobial inoculation on growth, yield, nodulation and biochemical characters of vegetable pea (*Pisum sativum*). *Acta Agronomica Hungarica*, 57(1): 47–56.

Kumar, R., Yadav, S. L., Kumar, T., Singh, S. and Chourasia, P. C. (2011) Effect of Phosphorus, Sulphur and PSB on Yield and Yield Attributing Characters of Pea (*Pisum sativum* L.) under Vertisols. *Advances in Life Sciences* 5(24): 11230-11234.

Munsell, A. H. (1921) Munsell's description of his colour system, from a lecture to the American Psychological Association. *American Journal of Psychology* 23(2): 236-244.

Muthuvel, P., Udayasoorian, C., Natesan, R. and Ramaswamy, P. P. (1992) Introduction to Soil Analysis, *Tamil Nadu Agricultural University Coimbatore*-641002.

Negi, S., Dwivedi, G.K. and Singh, R.V. (2006) Integrated Nutrient Management Through Biofertilizers, Organic Manure and Lime for Vegetable Pea in an Acid Inceptisol of Cool Temperate Region of Uttaranchal. *Legume Res*. 30 (1): 37-40.

Olsen, S. R., Cole, C. V., Watanabe, F. S. and Dean, L. A. (1954) Estimation of available phosphorus in soils by extraction with sodium bicarbonate ($NaHCO_3$), *U.S.D.A. Circular*. 939: 1-19.

Singh, D. K., Singh, A. K., Singh, S. K., Singh, M. And Srivastava, O. P. (2015) Effect of Balanced Nutrition on Yield and Nutrient Uptake of Pea (*Pisum stivum* L.) Under Indo-Gangetic Plains of India. *The Bioscan*. 10(3): 1245-1249.

Subbiah, B. V. and Asiija, E. C. (1956) A rapid procedure for estimation of available nitrogen in soil. *Current Science.* 25(8): 259-260.

Toppo, A. K., David, A. A. and Thomas, T. (2017) Response of different levels of FYM, PSB and Neem Cake on soil health, yield attribute and nutritional value of field pea (*Pisum sativum* L.) var. ICARU. Journal of Pharmacognosy and Phytochemistry; 6(5): 167-170.

Toth, S. J. and Prince, A. L. (1949) Estimation of cation exchange capacity and exchangeable Ca, K and Na content of soil by flame photometer technique. *Soil Sci*., 67: 439- 445.

Vorob, V. A. (2000) Effective inoculation of leguminous plants in relation to provision of phosphorus and potassium and dependence on rhizosphere temperature. *Agrokhimiya*, 2: 42-44.

Walkley, A. and Black, I. A. (1947) Estimation of soil organic carbon by the chromic acid titration method. *Soil Science*. 47: 29-38.

Wilcox, L. V. (1950) Electrical conductivity Am. water work, Association. 42, 775-776.

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