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Effect of different fertilizers on biochemical parameters of stem and root of groundnut

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Abstract
Present study was done to evaluate the effect of different fertilizers on biochemical content of stem and root of groundnut. Five treatments named as T1 control, T2 chemical fertilizer, T3 cowdung, T4 vermicompost and T5 rhizobium biofertilizers with four replicates were conducted by complete randomized design method. Results revealed that in stem vermicompost significantly influenced total lipids (41.25±0.67 mg/gm), protein (170±0.32 mg/gm), total soluble sugars (10.39±0.09 mg/gm), starch (13.79±0.25 mg/gm) and total phenol content (1050±200 µg/gm) than biofertilizer, NP, cowdung and control treatment. Similarly total lipids (36.06±1.38 mg/gm), total soluble sugar (17.93±0.58 mg/gm), starch (13.32±0.24 mg/gm) and total phenol content (512.33±64 µg/gm) in dry powder of roots of groundnut showed significant increase with vermicompost than biofertilizer, NP , cowdung and control treatment. In roots protein (179.33±2.31 mg/gm) content reported maximum with vermicompost but not significantly different from other treatments.

Keywords: effect, different fertilizers, on biochemical parameters, of stem and root

Introduction

Groundnut is one of the major oil producing crops of the world. Its seeds contain 23.5-26.6% protein, 49.8-53.4% fat and sufficient level of lysine and threonine for human need. It also contains total saturated fatty acid 15-18%, ratio of oleic/ linoleic ratio is 1.3-1.4, alpha tocopherol 90-150 ppm and gamma tocophherol 270-570 ppm (Campos-Mondragón *et al*. 2009) [8]. It is also good source of carbohydrate 10-25 %, vitamins (E, K, and B complex) and minerals (Ca, P, Mg, Zn and Fe). Groundnut haulms are an energy rich fodder for cattle. Peanut skin is rich in phenolic compounds and used in treatment of chronic hemorrhage and bronchitis at China. Peanut butter and paste are also used to improve flavor, stability and antioxidant capacity of food. Peanut cake is used in animal feed, food for children and old people. Peanut shell is used in fuel and animal feed and making of alcohol and acetone. Root of groundnut adds nitrogen and organic matter to the soil (Variath and Janila, 2017) [24]. Utilization of chemical pesticides in India and Rajasthan was 62193 and 2330 MT Tech. Grade respectively during 2020-21. The long term application of inorganic fertilizers disrupts soil biological properties in respect of dominant soil species and structural and functional diversity of soil. Chemical fertilizers influence soil reaction and electrical conductivity and reduce soil enzyme activity *viz*. dehydrogenase, urease, sacharase, catalase, invertase, arylsulphatase and caseine protease (Pahalvi *et al*. 2021) [17]. Biofertilizers increase yield and nutrient of human food and they are safe for environment including plant & animals and human beings. They ensure availability of NPK, minerals and vitamins in plant rhizosphere for sustainable growth (Akram *et al*. 2020) [1]. Sustainable agriculture is about growing nutritive and safe foods by using biological based organic and biofertilizers without recourse of agrochemicals (Ashiya and Rai, 2017) [4]. Musa and Singh (2015) [16] reported increase in number of pods, pod yield and grain yield with 15 t ha^{-1} cow dung treatment in Ex-daker variety than RMP-12 variety of groundnut. Cattle manure application + effective microorganism (EM) influenced the number of pods, pod weight, number of kernel, 100 kernel weight and total yield as compared to chemical fertilizers. So cattle manure can replace chemical fertilizers (Seran and Suthamathy, 2013) [22]. Cow dung is very effective alternative of chemical fertilizers in enhancing productivity, soil health and microbial population in long term. Proper application of cow dung in sustainable way enhances yield and minimizes fungal and bacterial diseases (Raj *et al*. 2014) [20]. The present study has been carried out to explore the response of DAP (inorganic fertilizer), cowdung and vermicompost (organic fertilizer) and Rhizobium biofertilizer in pot experiment on biochemical contents of stem and root of Groundnut (*Arachis hypogaea* L.).

Material and Methods

Present experiment was done at Department of botany, University of Rajasthan located at 28°53'23" North latitude and 75°49'04" East longitude. A complete randomized design (CRD) method was adopted to evaluate the effect of DAP, cowdung, vermicompost and biofertilizer on biochemical content of root and shoot dry mass, five treatments with four replicates were taken named as T1 control (no fertilizer and manure in pot with 10 kg soil), T2 NP 15:60 (Diamonium phosphate .59 gm DAP in pot with 10 kg soil), T3 cowdung (45.50 gm cowdung in pot with 10 kg soil), T4 vermicompost (45.50 gm vermicompost in pot with 10 kg soil) and T5- biofertilizer (5 ml Rhizobium biofertilizer in 10 kg soil and seed treatment). Vermicopost and cowdung were added to pots 15 and 30 days respectively before seed sowing. Rhizobium biofertilizer was applied by seed inoculation and soil inoculation method with 10% sugar slurry before sowing seeds. DAP applied in two splits first before seed sowing and second during flowering of groundnut. Pots were irrigated twice in a week. Seeds were sown in July 2018 during rainy season. The minimum and maximum temperature during the growing season was ranged between 23-33 °C and 29-42 °C respectively. After completing life cycle of groundnut plants stems and roots were shade dried and powdered. This dry matter was used for biochemical analysis of protein, total lipids, total soluble sugar, starch and phenols. Total phenol content was evaluated by sepctrophotometeric method described by Bray and Thorpe (1954) [7] by using Foin-Ciocalteu phenol reagent and gallic acid. Total soluble sugars were quantified by phenol-sulphuric acid (Dubois *et al*. 1951) [10] method. Starch content estimated by method developed by Mc Cready *et al*. (1950) [14] using perchloric acid. Protein content was evaluated by Lowry *et al*. (1951) [12] method using bovine serum albumin and trichloro-acetic acid. Total lipid content was estimated by method described by Barnes and Blackstock (1973) [5].

Statistical analysis was done by using OPSTAT, Analystat and MS excel software. Standard error mean (SEm±) and critical difference (CD) taken at .05 probability level. One Way ANOVA, t test and Post Hoc Dunnett's test was done to evaluate the significance level, difference between the groups.

Result and Discussion

Total lipids in stem were analyzed 21.56±2.87, 28.06±1.05, 24.62±2.02, 41. 25±0.67 and 33.20±0.44 mg/gm in T1, T2, T3, T4 and T5 respectively. Total lipids in roots were estimated 24.82±1.62, 30.38±1.76, 27.79±2.36, 36. 06±1.38 and 34.07±0.91 mg/gm in T1, T2, T3, T4 and T5 treatments respectively. Total lipids in stem and root were significantly influenced by vermicompost followed by rhizobium biofertilizer application (T5) than other fertilizers and control. Increased oil content in groundnut by vermicompost treatment than nitrogen and phosphorous fertilizers was reported by Bekele *et al*. in 2019 [6]. Bacteria strains (*Lysinibacillus xylanilyticus* and *Bacillus licheniformis*) isolated from cow dung were shown to exhibit specific role in plant growth like IAA production, P solubilization, antagonism to *Rhizoctonia bataticola* (Radha and Rao, 2014). Protein content in stem was reported 132.67±0.53, 156.8±0.72, 154.13±0.73, 170±0.32 and 167.47±0.22 in T1, T2, T3, T4 and T5 treatments respectively. Protein content in roots was recorded 161±14.73, 175.33±5.77, 162±10.58, 179.33±2.31 and 176.67±7.51 in T1, T2, T3, T4 and T5 treatments respectively. Protein content in stem and root were significantly increased with vermicompost treatment (T4) followed by rhizobium biofertilizer treatment (T5) than other fertilizers and control. Similar influence in root protein was reported in groundnut with vermicompost treatment than control (Mathivanan *et al*. 2013) [13]. Patel *et al*. (2016) [18] reported maximum protein content with vermicompost treatment than rhizobium, urea and control in seedling of soybean (Glycine max).

Total soluble sugar content in stem was analyzed 9.05±0.14, 10.23±0.20, 9.47±0.6, 10. 39±0.09 and 10.25±0.13 mg/gm in T1, T2, T3, T4 and T5 treatments respectively. Starch in stem was reported 9.43±0.06, 11.53±0.31, 9.95±0.13, 13. 79±0.25 and 11.53±0.23 mg/gm in T1, T2, T3, T4 and T5 respectively. Total soluble sugar in root was reported 8.3±0.1, 10.45±0.35, 9.03±0.12, 17. 93±0.58 and 13.33±0.23 mg/gm in T1, T2, T3, T4 and T5 respectively. Starch in root was analyzed 10.11±0.01, 11.33±0.12, 10.23±0.23, 13.32±0.24 and 13.32±0.24 mg/gm in T1, T2, T3, T4 and T5 treatments respectively. Total soluble sugar and starch in stem and root were significantly increased with vemicompost application (T4) followed by biofertilizer (T5) treatment as compared to cowdung, NP and control. Similar results have been reported by other author also. Sugar content in root portion was found influenced with the application of vermicompost treatment as reported by Mathivanan *et al*. in 2013 [13]. Application of vermicompost significantly influencing the starch and sugar content in some selected potato varieties was reported by Ferdous *et al*. in 2019. The humic acid present in vermicompost work as molecular elicitors of H^+ and ca+2 fluxes, which seem to be upstream of CDPK signaling cascade and causes plant growth and development (Ramos *et al*. 2015) [21]. Influence in TSS content with vermicompost + NPK, than cow dung + NPK and control in mustard crop as reported by Mondal *et al*. in 2017 [15]. (T4) followed by biofertilizer (T5) than other treatments and control. Organic fertilizer influenced greatly the total phenolics content than conventional chemical fertilizers (Sousa *et al*. 2008) [23]. Influence in total phenol content with vermicompost treatment compare than organic and inorganic fertilizers was also reported by Antonious *et al*. (2019) [3] and Alaghemand *et al*. (2017) [2].

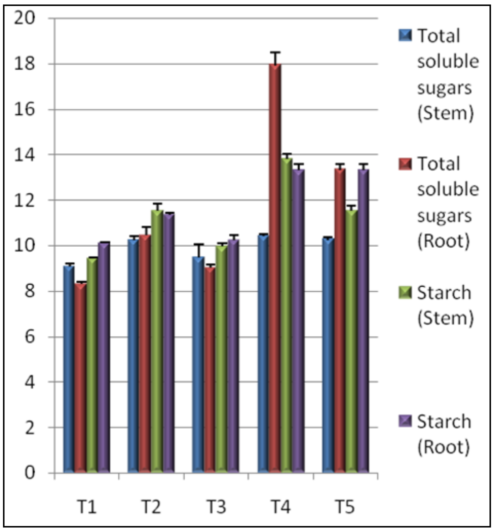

Fig 1: Effect of chemical fertilizer, cowdung, vermicompost and rhizobium biofertilizer on total soluble sugars and starch content of root and stem of groundnut.

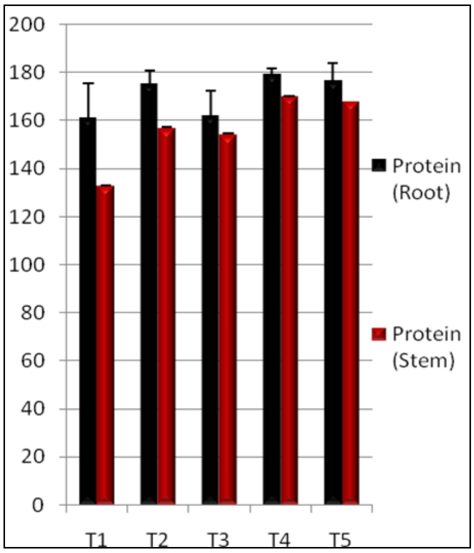

Fig 2: Effect of chemical fertilizer, cowdung, vermicompost and rhizobium biofertilizer on protein content of root and stem of groundnut.

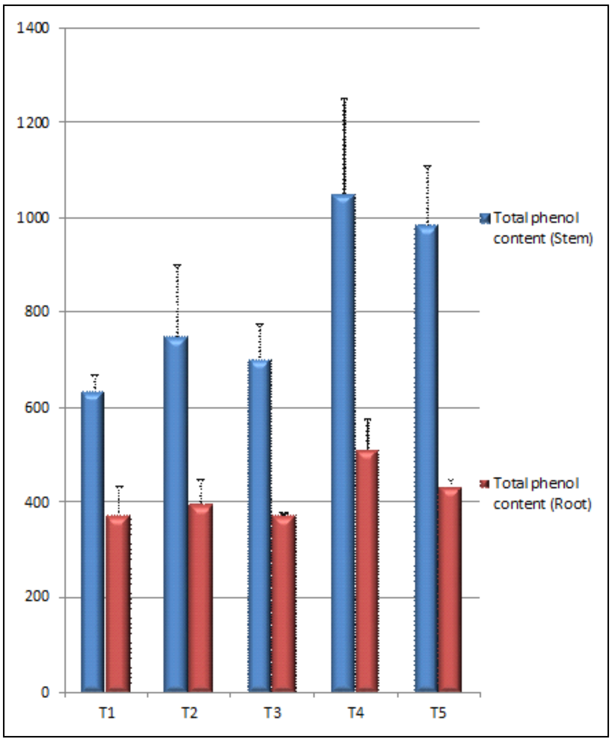

Fig 3: Effect of chemical fertilizer, cowdung, vermicompost and rhizobium biofertilizer on total phenol content of root and stem of groundnut.

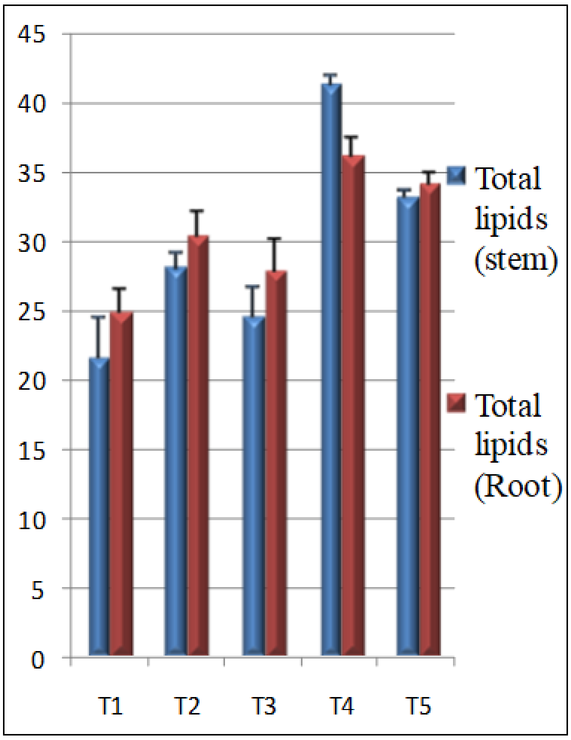

Fig 4: Effect of chemical fertilizer, cowdung, vermicompost and rhizobium biofertilizer on total lipid content of root and stem of groundnut.

Table 1: Effect of chemical fertilizer, cowdung, vermicompost and rhizobium biofertilizer on biochemical content of stem of groundnut.

Treatments	Total lipids (Stem) mg/gm	Protein (Stem) mg/gm	Total soluble sugars (Stem) mg/gm	Starch (Stem) mg/gm	Total phenols (Stem) µg/gm
T1	21.56±2.87	132.67±0.53	9.05±0.14	9.43±0.06	635±34.64
T2	28.06±1.05**	156.8±0.72*	10.23±0.20***	11.53±0.31***	749±148.46 NS
T3	24.62±2.02 NS	154.13±0.73 NS	9.47±0.6*	9.95±0.13 NS	702.83±68.99 NS
T4	41.25±0.67***	170±0.32**	10.39±0.09***	13.79±0.25***	1050±200*
T5	33.20±0.44***	167.47±0.22**	10.25±0.13***	11.53±0.23***	984.17±122.48*
SEm±	.968	4.717	0.075	0.124	74.388
CD (0.05)	3.088	15.056	0.241	0.396	237.430

***=p < 0.001, **=p < 0.01, *=p < 0.05, NS=Non-significant

Table 2: Effect of chemical fertilizer, cowdung, vermicompost and rhizobium biofertilizer on biochemical content of root of groundnut.

Treatments	Total lipids (Root) mg/gm	Protein (Root) mg/gm	Total soluble sugars (Root) mg/gm	Starch (Root) mg/gm	Total phenols (Root) µg/gm
T1	24.82±1.62	161±14.73	8.3±0.1	10.11±0.01	373.67±59.17
T2	30.38±1.76*	175.33±5.77 NS	10.45±0.35***	11.33±0.12***	396.33±52.15 NS
T3	27.79±2.36 NS	162±10.58 NS	9.03±0.12 NS	10.23±0.23 NS	374.83±3.17 NS
T4	36.06±1.38***	179.33±2.31 NS	17.93±0.58***	13.32±0.24***	512.33±64.67*
T5	34.07±0.91***	176.67±7.51 NS	13.33±0.23***	13.32±0.24***	432.5±16.45 NS
SEm±	0.967	5.13	0.188	0.111	26.689
CD (0.05)	3.085	NS	0.601	.355	85.185

***=p < 0.001, **=p < 0.01, *=p < 0.05, NS=Non-significant

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