EFFICIENCY OF INDIVIDUAL AND SYNERGISTIC COMBINATIONS OF VARIOUS FERTILIZERS ON SEED GERMINATION OF *VIGNA MUNGA* (L.) Hepper AND *VIGNA RADIATA* (L.) R. Wilczek

S. Anbu Radhika*, A. Eswari, A. Gangaparameshwari, M. Mariammal and S. Sakkammal Sakthi

PG and Research Department of Zoology, Pasumpon Muthuramalinga Thevar College, Melaneelithanallur, Sankarankovil, Tenkasi.

Corresponding author *Email ID: sanburadhika90@gmail.com

Abstract

Organic fertilizers are an environmental friendly and economic process to germinate plants. The objective of this study was to produce highest plant growth within a short period with organic fertilizer either individual or combinations were tried. The synergism was come out well. The combination of Coco-bit +Tea extract (CT), Cow dung + Egg shells (CE) and Sprouts + Lemon (SL) were tried. synergism exhibit highest germination percentage from CT in paper towel method after seven (100%) and ten days (98%) on green gram respectively, and in black gram paper towel method after seven (100%) and ten (95%) days maximum growth recorded in CE combinations. The individual organic fertilizers with inorganic NPK fertilizer were also used for germination, water act as a control. The lowest germination percentage were recorded in NPK inorganic fertilizer and also lemon and sprouts as individual development after seven and days of paper towel method and pot method. The CT and CE combinations are greatly induced black gram and green gram germination respectively in pot method after ten days of experiment. The study concluded that the synergistic activity of organic fertilizer induced the plant growth significantly when compared to their individual performance in both black gram and green gram. Among all the fertilizers CE and CT recommended for use of its high germination to black gram (Pot method) and green gram (paper towel method) germination.

Key Words: Germination, Black Gram, Green Gram, fertilizer, growth

I. INTRODUCTION

Agriculture is the main source of national income for most developing countries. agriculture can be called the backbone of India's economy. agriculture plays vital role in the Indian economy. As roughly 70-75% of the population depends directly or indirectly on agriculture. In agricultural systems, the extensive application of chemical fertilizers to increase crop productivity has caused considerable damage to the ecology and has even depressed the nutritional quality of crops. A focus on organic farming for health consideration and also to meet the stringent consumer standards, agricultural practices are increasingly being modified (Kramer et al., 2006).

Cereal grains are one of the main staple food crops, yet are notably deficient in the essential amino acids (Joye, 2019). Germination is one of the most effective processes to enhance the nutritional value of cereals and legumes. This process could provide some advantages, including an improvement in available carbohydrates, dietary fiber, free amino acids, and other compounds; enhancement in the nutritive value of the seeds, such as vitamin concentration; bioavailability of trace elements and minerals; reduction in the amount of phytic acid; reduction in raffinose and stachyose as flatulence factors; and a reduction in the caloric content of seeds (Fayyaz et al., 2018; Pakfetrat et al., 2019). Besides the mentioned advantages, the authors considered whether it would be possible to increase the nutritional value of germs and simultaneously control the microbial contamination of germs, which is the main challenge of malting.

Organic materials and fertilizers improve the soil texture, allowing it to hold water longer and increase the bacterial and fungal activity in the soil so, they not only assist your plants, they help the soil. organic fertilizers work slowly. In orders for organic fertilizers to work the soil has to first break them down. This means that both the soil, and the plants in it get the nutrition they need when they need it synthetic fertilizers although speedy, often overfeed the plant, do nothing for the soil, and can damage plants by burning them. organic materials and fertilizers improve the soil texture, allowing it to hold water longer, and increase the bacterial and fungal activity in the soil. so, they not only assist your plants, they help the soil. Synthetic fertilizers, on the other hand, despite the soil its nutrients making it unproductive good luck growing these juicy tomatoes in unproductive soil. the quantity of many factors among which is the most important one is technique of fertilization.

Citrus fruit waste contains a high concentration of fertilizer elements (El-Mahrouk and Dewir, 2016; Ferrer et al., 2001), which makes it suitable for composting. However, it also contains a high amount of polyphenols (Arvanitoyannis et al., 2006; El-Mahrouk and Dewir, 2016; Lazze et al., 2009), which might inhibit the microbial growth in the plant root zone (Ben Jenana et al., 2009; Mandelbaum et al., 1988) but makes it less effective as a composting material. The use of bio-fertilizer and organic fertilizers are healthy practices for economical production in place of synthetic fertilizer. Organic farming is a system of ecological soil managements that relies, in part or it full, the rotation of crop, organic waste amendments, balanced mineral nutrient management, and mechanical and biological controls

on building organic matter with minimum adverse effects on soil health. Organic fertilizers are just as easy to apply as their synthetic non-organic counter parts. Adding them to soil or spraying them on leaves-however you use them they add countless benefits to your garden while providing the same amount of convenience and ease as chemical fertilizers.

In India, pulses are mostly cultivated on marginal soils under rainfed situations with minimum external nutrient input. Farmers often fail to apply essential nutrients. The result is very low crop yields- the current average hovers at about 700 kg/ha. The important grain legumes grown in India are chickpea, pigeon pea, green gram, black gram, cowpea, lentil and peas etc. (Rathiya*et al*., 2018). Globally over tow billion tones of grains are produced annually the grains stored at different stages of the grain distribution chain, in defined units such as a bags, soils, warehouses containers and even in piles on the grounds. In the countries where grain storage losses are high, the growth in population is also high leading to increase in food demands. Another advantage of proper storage systems is the improved health of human animals who consume grains seed quality is very important to optimum growth and yield production in farm which influenced by many factors such as genetic characteristics, viability, germination percent, vigor, moisture content, storage conditions, survival ability and seed health, but their most important is germination percent and vigor (Akbari et al., 2004). mechanical damages, seed storage, age and aging and pathogens, affect seed germination and vigor. One of the important criteria in seed vigor is the amount to dry matter (seed storage) or the seed weight. Germination and seedling emergence requires a lot of energy that prepared through the oxidation of seed storage. seed should be has adequate food supply for seedling growing because seedling until enough growth, is dependent to seed (Garnish).

Green Gram (GG) or Mung bean (*Vigna radiate* (L.) R. Wilczek), an important leguminous crop, is widely cultivated and used in kinds of cuisines across Asia and some parts of South and North America and Australia, and is rich in nutrients such as protein and iron (Peñas et al., 2010; Dahiya et al., 2015). After soaking mung bean in water and incubating under certain temperature and humidity conditions for several hours, the germinated mung bean named mung bean sprouts can be harvested. Germinated mung bean sprouts are popular oriental vegetables vended in public markets because of wide availability and high nutritional and medicinal values (Gabriel et al., 2007; Mubarak, 2005). The sprouts are available all year round and good sources of dietary proteins, carbohydrates, minerals and vitamins comparable to those found in the more expensive animal and marine sources. Nevertheless, many factors can result in a considerable loss in production, nutritional value and economic yield of mung bean sprouts, especially microbial diseases and physiological deterioration (Randeniya& de Groot, 2015). Various methods such as genetic engineering, physical intervention technologies and chemical addition have been developed to achieve considerable improvement in agricultural efficiency. Ashraf & Akram (2009) suggested that genetic engineering, an alternative strategy to conventional breeding, was being employed emphatically worldwide these days not only for improving stress tolerance but also for improving the quality and yield potential of most crops.

Black gram (BG) (*Vigna mungo* L, Hepper), an ancient and well known leguminous crop of Asia, is popular because of its nutritional quality (protein). Black gram is a highly priced pulse, rich in protein (24%) and phosphoric acid. Besides their dietary value and nitrogen fixing ability, pulses also play an important role in sustaining intensive agriculture by improving physical, chemical and biological properties of soil and are considered excellent crops for diversification of cereals-based cropping systems. Urad dal (BG) is filled with magnesium, phosphorus, iron, potassium and calcium. These minerals strengthen your bone mineral density and reduce your chances of getting osteoporosis black gram a fantastic source of protein. Pulses are mainly grown in marginal land and poor productivity of the crop is mainly due to inadequate nutrient supply. However, non-injudicious use of chemical fertilizer resulted in deterioration of soil physical and chemical properties and its productivity. Integration of recommended dose of fertilizer along with essential elements *viz;* boron, molybdenum that are deficient under rainfed light textured soil would result in better yield of black gram under rainfed condition, slow and steady release of these inorganic fertilizers would increase the availability of nutrients, which will result in translocation of more photoynthates from source to sink and finally improve the yield attributing character.

High amounts of iron and aluminium in acid soils favour formation of complexes with boron and molybdenum results in its higher deficiency in acid soil (Sing, 2006). Molybdenum, being a constituent of nitrate reductase and nitrogenase enzymes, is associated with ammonia reduction and nitrogen fixation and its deficiency adversely affects growth and yield of black gram. Improvement in seed yield of black gram through use of Boron is very important in cell division and in pod and seed formation. Therefore, applications of micronutrients in addition to essential major elements have gained practical significance. Molybdenum is important for good foliage growth of higher plants. It involved in the process in nitrogen fixation, nitrate reduction and nitrogen metabolism (Battacharyya et al., 2004).

Germination and emergence are the two most important stages in the life cycle of plants that determine the efficient use of the nutrients and water resources available to plants (Gan, 1996). Environmental factors such as temperature, light, pH, and soil moisture are known to affect seed germination (Rizzardi et al., 2009). Temperature plays a major role in determining the periodicity of seed germination and the distribution of species (Guan, 2009). In the germination process, the seed's role is that of a reproductive unit; it is the thread of life that assures survival of all plant species. Furthermore, because of its role in stand establishment, seed germination remains a key to modern agriculture. Thus, especially in a world acutely aware of the delicate balance between food production and world population, a fundamental understanding of germination is essential to crop production. Germination is the process by which an organism grows form a seed or similar structure Germination is usually the growth of a plant contained within a seed it results in the formation of the seedling. Seed germination depends on both internal and external conditions. The most important external factors include right temperature water oxygen or air and sometimes light or darkness and fertilizers.

In the process of seed germination water is absorbed by the embryo which results in the rehydration and expansion of the cells. shortly after the beginning of water uptake or inhibition the rates of respiration increases and various metabolic process and suspended or much reduced during dormancy resume. The importance of seeds is biological and economic. They have large amounts of protein, starch and oil which are all important nutrients for the development if plants and humans. They are used in the production of many primary food sources for humans. The germination test or index has been subject to considerable controversy ever since it was proposed by Zucconi et al. (1981). Many researchers use Zuccuoni et al.'s cress test (Iannotti et al., 1994; Erhart and Burain, 1997; Pare et al., 1997; Sesay et al., 1997). However, there have been a number of variations to the procedure and many scientists have proposed seed soaks and direct seeding into compost or compost -peat mixtures (Gajdos 1997; Garcia et al., 1992; Inbar et al., 1993; Keeling et al.,

1994; Warman and Termeer 1996) as alternatives to the pressure extraction method of Zuccooni et al. (1981). Furthermore, researches have used other plant species besides cress for seed germination and plant growth tests; some examples are sunflower (Baca et al. 1990; Murillo et al., 1995), chinese cabbage (Wong and Chu, 1985; Warmann and Termeer, 1996), radish (Iannotti et al., 1994; Gajdos, 1997); ryegrass (Inbar et al.,1993; Iannotti et al., 1994; Keeliing et al., 1994; Murillo et al., 1995; Gajdos, 1997), barley (Ligneau and Watt, 1995; Pascual et al., 1997) and various other slow-germinating vegetable species (Roe et al., 1997; Warman and Termeer, 1996). Considering the above factors, the present experiment has been undertaken to evaluate the possible effects of various combinations of cowdung, egg white, sprouts, lemon, coco-bit, tea extracts and inorganic NPK with synergistic action like CT, CE and SL combinations with different concentrations will apply to the germination of seeds like BG and GG.

II. MATERIALS AND METHODS

2.1. Preparation of Liquid Fertilizer

Combinations of organic material Coconut fiber + Tea powder extract (CT), Cow dung + Egg white (CE), Sprouts + Lemon (SL), their individual and positive (water) negative (NPK) control were collected from Sankarankovil in and around areas. They were individually and combinations were tried as fertilizer. They were rich in Vitamin C and folic acid which is useful for the growth of plant crops. The obtained liquid extract was designated as standard solution and was used Liquid Fertilizer with sterilized distilled water.

Healthy seeds of *Vigna radiate* (Green Gram - GG) and *Vigna mungo* (Black Gram - BG) were collected from Vegetable scientific research center, TNAU, Vallanadu, Tuticorin. The seeds surface were sterilized with 0.1% HgCl2 up to 1-2 minutes and washed with distilled water immediately then used for different germination methods. The seeds were socked in different Liquid Fertilizers up to 24-48 hours and then used for germination by two different methods: (1) Paper Towel and (2) Pot method.

2.2. Paper Towel Method

In paper towel method, different Liquid Fertilizer of Coco-bit +Tea extract (CT), Cow dung + Egg shells (CE) and Sprouts + Lemon (SL) and control (positive- water; negative- NPK) were used as base for the treatment of seeds of *Vigna radiate* (Green Gram - GG) and *Vigna mungo* (Black Gram - BG). In paper towel method, 50 treated seeds were placed in tissue paper by maintaining appropriate distance, fold the paper at four sites properly and spray the water to maintaining moisture content and put into zip locked bag carefully. After 12 days, % germination, shoot length and root length was measured under room temperature in natural condition.

2.3. Pot Method

After paper towel method screening of all treatment, again the above said combinations of liquid fertilizers were apply on pot method under natural condition. In pot method, pots filled with soil have sufficient quantity of NPK. The 50 treated seeds were sowed at appropriate distance and watered regularly. After 20 days, % germination, shoot length and root length was determined.

2.4. Statistical analysis

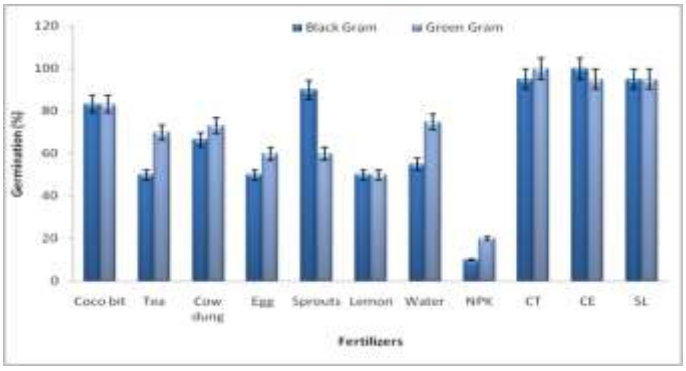
Statistical data of standard deviation were analyzed using SPSS13.0. All experiments are run in triplicates and the mean± standard error mean values were presented.Each experiment was repeated in triplicates and Mean ±Standard Deviation from absolute data was calculated (http://easycalcul ation.com/statistics/standard-deviation. php). To analyze the impact of different treatments on BG and GG growth and development, a one-way analysis of variance was used. Statistical analyses were performed using GraphPad Prism for Windows (version 5.03) and also used to plot graphs with error bars of standard errors of the means (SEM). ‘a, b, c’ indicates a significant difference between control and other treatment groups. Statistical icons: single letter such a/b/c ¼ p 0.05; double letter such as aa/bb/cc ¼ p 0.01; triple letter such as aaa/bbb/ccc, ¼ p 0.001.

III. RESULTS AND DISCUSSION

Seed germination is an internally regulated process influenced by genotype, external factors such as light, temperature, moisture, and the presence of certain chemical compounds (phytohormones or organic acids) also strongly influence this process (Finkelstein, 2004; Kucera et al., 2005).

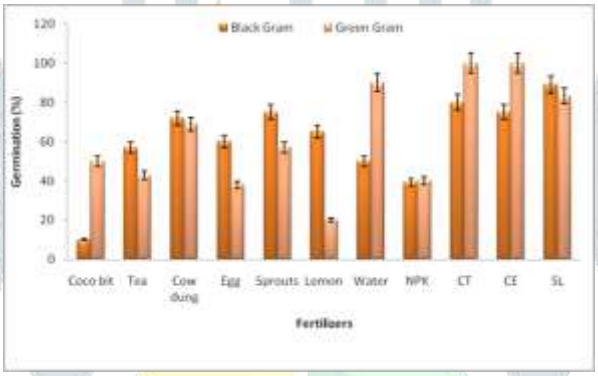
Inclusion of citrus at high percentage volumes (80%) as a substrate component suppressed root development, increased leaf necrosis, and had detrimental effects on pecan (*Carya illinoinensis*) seedling growth. The inhibition of seed germination and reduction of germination speed have been attributed to phytotoxic compounds that are released in the course of organic matter decomposition, such as ammonium, acetic acid, phenol, or low-molecular weight fatty acids (Zucconi et al., 1981). In the present study, the paper towel method after seven days both seeds are well germinated in combinations like CE (100% in BG), CT (100% in GG) as well as SL (95% in both BG and GG), but in individual fertilizer the germination was less in NPK (0%) for BG other than GG (**Fig 1**).

Figure 1. Germination percentage of Black Gram (BG) and Green Gram (GG) with various fertilizers after seven days in paper towel method.



An aqueous extract of Tea leaf, may contain a series of bioactive molecules as well as microbial populations derived from the parent material, which may be enhanced during the production of extracts (Ingham, 2005a; Scheuerell and Mahaffee, 2004). Whereas in pot method after seven days also the synergism were come out well for the seeds GG and BG. In CT and CE combinations germinate 100% in GG. Coco-bit and lemon has lowest germination in BG (10%) and GG (10%) respectively (**Fig 2**).

Figure 2. Germination percentage of Black Gram (BG) and Green Gram (GG) with various fertilizers after seven days in pot method.



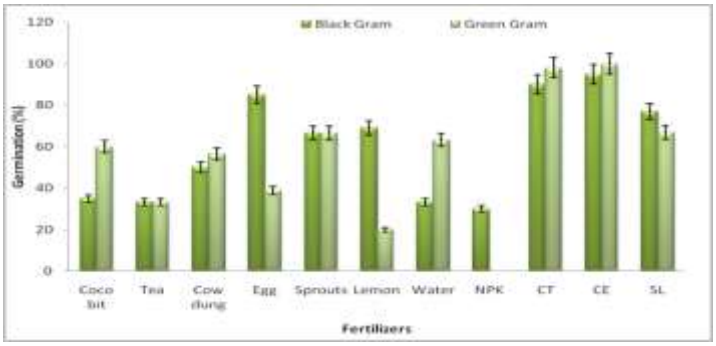
The roots suffer from much oxidative stress than that of leaves in the black gram seedlings treated with combinations like SL and individual as NPK, lemon, egg and water treated plants. However, as a whole the enhanced activities of antioxidant enzymes may produce scavenging reactive oxygen species for the improvement of adaptive response of black gram plants grown from the seeds treated with combinations of CE and CT. Cowdung can have a harmful effect on plants or germinating crops (Zucconi et al., 1981), as well as on soil life. Therefore, phytotoxicity may be an important indicator of dung quality. The concentrations of these factors in fresh dung, and thereby its phytotoxicity, is mainly determined by the composition of the feed. Therefore, it might be possible to influence dung phytotoxicity by adapting the feeding strategy.

One study suggested that the observed lower weight of marigold (*Calendula officinalis*) plants grown on peat, compared with those grown on two compost-based substrates, might be due to a lower availability of macronutrients (Garcıa Gomez et al., 2002). Our findings that pure compost is unsuitable as a growing medium are consistent with previous report by Spiers and Fietje (2000) as they concluded it is characterized by inadequate air space, high salt content, and high pH. Grape waste is rich in phenolic compounds, which have been shown to inhibit seed germination and seedling growth (Diaz et al., 2004). This effect has been reported in many species, such as 'Japonica' shirakamba birch [*Betula platyphylla* (Yukiko et al., 2001)], soybean [Glycine max (Colpas et al., 2003)], and cucumber [*Cucumis sativus* (Muzaffar et al., 2012)].

The NPK mixed inorganic fertilizer is not induced the germination at expected level. The application of a nano-engineered composite consisting of N, P, K micronutrients, mannose and amino acids enhance the uptake and use of nutrients by grain crops (Jinghua, 2004). Normal and nanofertilizers appeared to reduce the amount of malonyldialdehyde and ion leakage in treated wheat plants grown on clay, clay-sand or sand soils throughout the entire period of experiment, as reported by Oancea*et al*. (2009).

In addition, germination index and seedling growth are also the most significant parameters to show the biological vigor of seeds (Ling et al., 2014). In paper towel method after ten days of exposure again the synergism was achieved more germination percentage when compared to other individual fertilizers. Synergism CE observed 100% germination in both GG and BG. But other synergistic and individual fertilizers noticed minimum germination in NPK (0%), lemon (20%) and egg (33%) for GG (**Fig 3**).

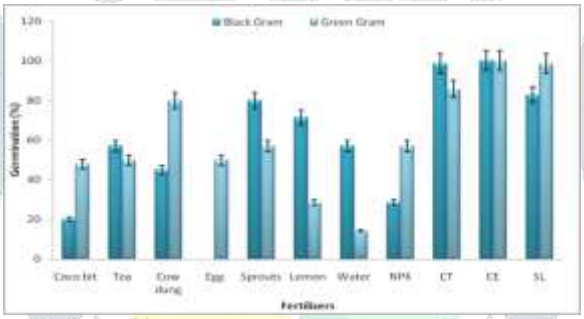
Figure 3. Germination percentage of Black Gram (BG) and Green Gram (GG) with various fertilizers after ten days in paper towel method.



Edible sprouts are young seedlings, obtained from seeds germination, which has high nutritional value. The current consumer trend is for natural, healthy and convenient food (Ma et al., 2019) and, as seed sprouts fall into this category, this fresh produce is increasingly in demand across the world. However, seed sprouts could be served as a fertilizer too. Seed germination is the most important phase in the growth cycle of plants, which starts at water absorption of seeds and followed by the expansion of seed embryos (Hermann et al., 2007).

With the increase of incubation time to 7 days, the plant length of Air-PTW treated seeds reached 12.01 cm, increased by around 100% compared with the control ones, showing noteworthy advantage to other treatments. In pot method after ten days the maximum germination (100%) was recorded in both BG and GG plants for synergism CE (**Fig 4**).

Figure 4. Germination percentage of Black Gram (BG) and Green Gram (GG) with various fertilizers after ten days in pot method.



CT observed 98% in BG and SL noticed 98% in GG. Basak and Lee (2001, 2002) reported that fresh cow urine and cow dung has positive response in suppression of mycelial growth of *F. solani*, *F. oxysporum* and *S. sclerotiorum.*The individual fertilizer germination was less in pot method the germination was recorded in water (14%) for GG, NPK (28%) and Coco bit (12%) for BG. The water holding capacity of rockwool was the highest followed by coconut fiber, bark and rice husk. the capacity decreased with the height of each substrate. The capacities of organic substrates increase with use. these substrates showed less water absorbing capacity at the beginning but became water absorbent once used. Coconut-fiber is there to be a promising environmentally friendly substrate for soilless culture. from this study, it appears other organic substrate, like bark and rice husk also have the potential as growing media in terms of environmental friendliness.

The increase in N, P_2O_5 and K_2O content of black gram with integration of recommended dose of fertilizer along with essential nutrients *viz;* boron, molybdenum might be due to that recommended dose of applied N, P and K supply optimum nutrient requirement to, so it gives maximum in N, P_2O_5 and K_2O content (Rajeshwari, 2011). The higher black gram yield might be due to integrated management of inorganic fertilizers with essential nutrients *viz;* boron, molybdenum, which help to increase the soil fertility through improvement in soil physical, chemical and biological characteristics.

Improvement in seed yield of black gram through use of Boron is very important in cell division and in pod and seed formation (Vitosh et al., 1997). Seed germination rate is found to increase with treatment duration. This phenomenon can be ascribed due to the significant (Soriano et al., 2013 and 2015) role played by the high nitrogen content, out of many seed reserve compounds, in seeds on enhanced germination rate of the black gram seeds. Overall, the addition of increasing percentage of tea extract gradually reduced the speed of growth of bacteria, yeasts and molds, and the loss of vitamins while accelerated the accumulation of minerals, thus improving the microbial and the nutritional quality of wheat grain during germination time (Pakfetrat et al., 2020).

IV. CONCLUSION

The present investigation conclude that, by using the paper towel and pot method i.e. use of different liquid fertilizers either by individual or synergism has examined, among the fertilizers the synergism of CE and CT has exhibited maximum germination percentage with better results as compare to control (water) as well as individual fertilizers. This is gone be a sign of the germination was perfect when used synergized fertilizers.

V. REFERENCES

[1]. Akbari, Gh. A. Ghasemi Pirbalouti, M. Najaf-Abadi Farahani, M. and Shahverdi, M. 2004. Effect of harvesting time on soybean seed germination and vigor. Journal of Agriculture, 6:9-18.

[2]. Arvanitoyannis, I.S. Ladas, D. and Mavromatis, A. 2006. Potential uses and applications of treated wine waste: A review. International Journal of Food Science and Technology, 41:475–487.

[3]. Ashraf, M. and Akram, N.A. 2009. Improving salinity tolerance of plants through conventional breeding and genetic engineering: an analytical comparison. Biotechnology Advances, *27*(6): 744-752.

[4]. Baca, M.T. Delagaro, I.C. Sanchez-Raya, A.J. and Gallardo-Lara, F. 1990. Comparative use of cress seed germination and physiological parameters of Helianthus ann us L. To assess compost maturation. *Biological Wastes*, 33:251-261.

[5]. Basak, A.B. and Lee, M.W. 2001. Comparative efficacy and *in vitro* activity of cow urine and cow dung for controlling Fusarium wilt of cucumber. Abstract published in the 2001 Korean Soc. Plant Path. Ann. Meet. Int. Con., held on the 25-30th October, Kyongju, Korea. Pp-49.

[6]. Basak, A.B. and Lee, M.W. 2002. *In vitro* inhibitory activity of cow urine and cow dung of *Fusarium solani* f. sp. *cucurbitae*. Mycobiology, 30(1): 51-54.

[7]. Ben Jenana, R.K. Haouala, R. Triki, M.A. Godon, J.J. Hibar, K. Ben Khedher, M. and Henchi, B. 2009. Composts, compost extracts and bacterial suppressive action on *Pythium aphanidermatum* in tomato. Pakisthan Journal of Botany, 41:315–327.

[8]. Bhattacharya, S.S. Mandal, D. Chattopadhyay, G.N. and Majumdar, K. 2004. Better Crops, 88 (4): 25-27.

[9]. Colpas, F.T. Ono, E.O. Rodrigues, J.D. and Passos, R.J. 2003. Effects of some phenolic compounds on soybean seed germination and on seed-borne fungi. Braz. Arch. Biol. Technol, 46:155–161.

[10]. Dahiya, P.K. Linnemann, A.R. Van Boekel, M.A. Khetarpaul, N. Grewal, R.B. and Nout, M. J. 2015. Mung bean: technological and nutritional potential. Critical Reviews in Food Science and Nutrition, 55:(5) 670-688.

[11]. Diaz, M.J. Madejon, E. Cabreera, F. Jimenez, L. and DeBertoldi, M. 2004. Using a second-order polynomial model to determine the optimum vinasse/grape marc ratio for in-vessel composting. Compost Sci. Util. 12:273–279.

[12]. El-Mahrouk, M.S. and Dewir, Y.H. 2016. Physico-chemical properties of compost based waste-recycling of grape fruit as nursery growing medium. American Journal of Plant Science, 7:48–54.

[13]. Erhart, E. and K. Burian. 1997. Evaluating quality and suppressiveness of Austrian biowaste composts. *Compost Science &Utilization*, 5(3):15-24.

[14]. Fayyaz, N. Mohebbi, M. and Milani, E. 2018. Effect of germination on nutrients, mineral, comparison on the nutritional properties and biological activities of kiwifruit (Actinidia) and their different forms products: how to make kiwifruit more nutritious and functional. Food Funct, 10: 1317–1329.

[15]. Ferrer, J. Paez, G. Marmol, Z. Ramones, E. Chandler, C. Marın, M. and Ferrer, A. 2001. Agronomic use of biotechnologically processed grape wastes. Bioresources Technology, 76:39–44.

[16]. Finkelstein, R.R. 2004. Hormones in seed development and germination, In: Davies, P.J. (ed.). Plant hormones: Biosynthesis, signal transduction and action. Kluwer Academic Publishers. Pp- 513–537.

[17]. Gabriel, A.A. Berja, M.C. Estrada, A.M.P. Lopez, M.G.A.A. Nery, J.G.B. and Villaflor, E.J.B. 2007. Microbiology of retail mung bean sprouts vended in public markets of National Capital Region, Philippines. Food Control, 18 (10): 1307-1313.

[18]. Gajdos, R. 1997. Effects of two composts and seven commercial cultivation media on germination and yield. Compost Science &Utilization, 5(1):16-37.

[19]. Gan, Y. 1996. Evaluation of select nonlinear regression models in quantifying seedling emergence rate of spring wheat. Crop Science, 369 (1): 165-168.

[20]. Garcıa-Gomez, A. Bernal, M.P. and Roig, M. 2002. Growth of ornamental plants in two composts prepared from agro-industrial wastes. Bioresources Technology, 83:81–87.

[21]. Guan, B. 2009. Germination responses of *Medicago ruthenica* seeds to salinity, alkalinity, and temperature. Journal of Arid Environmental, 73 (1): 135-138.

[22]. Hermann, K. Meinhard, J. Dobrev, P. Linkies. A. Pesek, B. Hess, B. Machacova, I. Fischer, U. and Leubner-Metzger, G. 2007. 1-Aminocyclopropane-1-carboxylic acid and abscisic acid during the germination of sugar beet (*Beta vulgaris* L.): a comparative study of fruits and seeds. Journal of Experimental Botany, 58: 3047–3060.

[23]. Iannotti, D.A. Grebus, M.E. Toth, B.L. Madden, L.V. and Hoitink, H.A.J. 1994. Oxygen respirometry to assess stability and maturity of composted municipal solid waste. f. Environ. Qual, 23:1177-1183.

[24]. Inbar, Y. Hadar, Y. and Chen, Y. 1993. Recycling of cattle manure: the composting process and characterization of maturity. *f. Environ. Qual.*, 22:857-863.

[25]. Ingham, E.R. 2005a. The compost tea brewing manual; latest methods and research. Soil Food Effects of vermicompost teas on plant growth and disease. Biocycle, 47:28–31.

[26]. Jinghua, G. 2004. Synchrotron radiation, soft X-ray spectroscopy and nano-materials. Journal of Nanotechnology, 1: 193-225. http:// dx.doi.org/10.1504/IJNT.2004.003729.

[27]. Joye, I. 2019. Protein digestibility of cereal products. Foods, 8: 1-14. https://dx.doi.org/10.3390/foods8060199.

[28]. Keeling, A.A. Paton, I.K. and Mullett, A.J. 1994. Germination and growth of plants in media containing unstable refuse-derived compost. Soil Biology and Biochemistry, 6:767-772.

[29]. Kramer, S.B. Reganold, J.P. Glover, J.D. Bohannan, B.J.M. and Mooney, H.A. 2006. Reduced nitrate leaching and enhanced denitrified activity and efficiency in organically fertilized soils. PNAS, 103**:** 4522-4527.

[30]. Kucera, B. Cohn, M.A. and Leubner-Metzger, G. 2005. Plant hormone interactions during seed dormancy release and germination. Seed Science and Research, 15:281–307.

[31]. Lazze, M.C. Pizzala, R. Gutierrez Pecharroman, F.J. Gaton, P.G. Antolın Rodrıguez, J.M. Fabris, N. and Bianchi, L. 2009. Grape waste extract obtained by supercritical fluid extraction contains bioactive antioxidant molecules and induces anti-proliferative effects in human colon adeno-carcinoma cells. Journal of Medicinal Food, 12: 561–568.
[32]. Ligneau, L.A. and Watt. T.A. 1995. The effects of domestic compost upon the germination and emergence of barley and six arable weeds. Annals of Applied Biology, 126:153-162.
[33]. Ling, L. Jiafeng, J. Jiangang, L. Minchong, S. Xin, H. Hanliang, S. and Yuanhua, D. 2014. Effects of cold plasma treatment on seed germination and seedling growth of soybean. Scientific Reports, 4: 58-59.
[34]. Ma, T.T. Lan, T. Ju, Y.L. Cheng, G. Que, Z.L. Geng, T.H. Fang, Y.L. and Sun, X.Y. 2019. Seeds for stimulation of germination, removal of surface contamination and other benefits: a review. Plasma Processes and Polymers, 12(7): 608-623.
[35]. Mandelbaum, R. Hadar, Y. and Chen, Y. 1988. Composting of agricultural wastes for their use as container media: Effect of heat treatments on suppression of Pythium aphanidermatum and microbial activities in substrates containing compost. Biological Wastes, 26:261–274.
[36]. Mubarak, A.E. 2005. Nutritional composition and antinutritional factors of mung bean of high pressure, temperature and antimicrobial products on germination of mung bean seeds and microbial quality of sprouts. Food Control, 21(1): 82-88.
[37]. Murillo, J.M. Cabrera, F. Lopez, R. and Martin-Olmedo, P. 1995. Testing low quality urban composts for agriculture: Germination and seeding performance of plants. Agricultural Ecosystem Environment, 54:27-135.
[38]. Muzaffar, S. Ali, B. and Wani, N.A. 2012. Effect of catechol, gallic acid and pyrogallic acid on the germination, seedling growth and the level of endogenous phenolics in cucumber (*Cucumis sativus* L.). International Journal of Life Sciences, Biotechnology and Pharmaceutical Research, 1:50–55.
[39]. Oancea, S. Padureanu, S. and Oancea, A.V. 2009. Growth dynamics of corn plants during anionic clays action. Lucrări Ştiinţifice, Seria Agronomie, 52: 212-217. http://www.revagrois.ro/PDF/2009_1_214.pdf.
[40]. Pakfetrat, S. Amiri, S. Radi, M. Abedi, E. and Torri, L. 2019. Reduction of phytic acid, aflatoxins and other mycotoxins in wheat during germination. Journal of the Science of Food and Agriculture, 99: 4695–4701. https://doi.org/10.1002/jsfa.9710.
[41]. Pakfetrat, S. Amiri, S. Radi, M. Abedi, E. and Torri, L. 2020. The influence of green tea extract as the steeping solution on nutritional and microbial characteristics of germinated wheat. Food Chemistry, doi: https://doi.org/10.1016/j.foodchem.2020.127288
[42]. Pare, T. Gregorich, E.G. and Dinel, H. 1997. Effects of stockpiled and composted manures on germination and initial growth of cress (*Lepidium sativum*). Bio Agriculture and Harticulture, 14:1-11.
[43]. Pascual, J.A. Ayuso, M. Garcia, C. and Hernandez, T. 1997. Characterization of urban wastes according to fertility and phytotoxicity parameters. Waste Management and Research, 15:103-112.
[44]. Peñas, E. Gómez, R. Frías, J. and Vidal-Valverde, C. 2010. Effects of combined treatments phytic acid and enzyme activity of mung bean. Acta Medica Mediterranea, 34: 597–604. https://doi.org/10.19193/0393-6384_2018_2s_94.
[45]. Rajeshwari, H.J. 2011. Integrated nutrient management in blackgram (*vigna mungo* l.) in northern transition zone of Karnataka. M.Sc. (Ag.) Thesis, Department of Agronomy, University of Agricultural Sciences, Dharwad. 2011.
[46]. Randeniya, L.K. and de Groot, G.J. 2015. Non-thermal plasma treatment of agricultural seeds (*Phaseolus aureus*) as affected by some home traditional processes. Food Chemistry, 89(4): 489-495.
[47]. Rathiya, G.R. *et al.*, 2018. Response of Balanced Fertilization on Soil Nutrient Status, Growth and Yield of Blackgram. International Journal of Agriculture Sciences, ISSN: 0975-3710 & E-ISSN: 0975-9107, 10 (2): 5043-5045.
[48]. Rizzardi, M.A. et al. 2009. Effect of cardinal temperature and water potential on morning glory (Ipomoea triloba) seed germination. Planta Daninha, 27 (1): 13-21.
[49]. Scheuerell, S.J. and Mahaffee, W.F. 2004. Compost tea as a container medium drench for suppressing seedling damping-off caused by *Pythium ultimum*. Phytopathology. 94:1156–1163.
[50]. Sesay, A.A. Lasaridi, K. Stentiford, E. and Budd, T. 1997. Controlled composting of paper pulp sludge using the aerated static pile method. Compost Science and Utilization, 5(1):82-96.
[51]. Singh, M.V. 2006. Micro and secondary nutrients and pollutant element Research in India. AICRP Micronutrient. IISS, Bhopal, 26:1-82.
[52]. Soriano, D. López, S.A. Sánchez, E.Z. Segovia, A.O. and de Buen, A.G. 2015. South African Journal of Botany, 97: 149.
[53]. Soriano, D. Huante, P. Buen, A.G. and Segovia, A.O. 2013. Plant Ecol. 214: 1361.
[54]. Spiers, T.M. and Fietje, G. 2000. Green waste compost as a component in soilless growing media. Compost Sci. Util., 8:19–23.
[55]. Vitosh, M.L. Wameke, D.D. and Luca Boron, R.E. 1997. Mishigan State University Extension Soil and Management Fertilizer. Available on the http://www.Msue.msu.EDV.
[56]. Warman, P.R. and Termeer, W.C. 1996. Composting and evaluation of racetrack manure, grass clippings and sewage sludge. Bioresource Technology, 55:95-101.
[57]. Wong, M.H. and Chu, L.M. 1985. The response of edible crops treated with extracts of refuse compost of different ages. Agricultural Wastes, 14: 63-74.
[58]. Yukiko, I. Yasuoand, K. and Minoru, T. 2001. Effects of phenolic compounds on seed germination of shirakamba birch, Betula platyphylla var. japonica. Eurasian Journal of Forest and Research, 2:17–25.
[59]. Zucconi, F. Pera, A. Forte, M. and de Bertoldi. M. 1981. Evaluating toxicity of immature compost. BioCycle, 2(2):54-57.