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Sanjay Babu
Research Scholar, Department of Seed Science and Technology, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh, India

CL Maurya
Professor, Department of Seed Science and Technology, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh, India

Sarvendra Kumar
Professor, Department of Genetics and Plant Breeding, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh, India

Anil Kumar
Professor, Department of Soil Science and Agricultural Chemistry, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh, India

Rajeev Kumar
Professor, Department of Crop Physiology, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh, India

Yogesh Kumar
Professor, Department of Crop Physiology, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh, India

Rohit Yadav
Research Scholar, Department of Agronomy, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh, India

Ajay Pratap Singh
Research Scholar, Department of Seed Science and Technology, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh, India

Yogendra Pratap Singh
Research Scholar, Department of Seed Science and Technology, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh, India

Narang Kapoor
Research Scholar, Department of Seed Science and Technology, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh, India

Corresponding Author:
Sanjay Babu
Research Scholar, Department of Seed Science and Technology, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh, India

Effect of botanicals and novel molecules of insecticides on seed quality of mungbean (*Vigna radiate* L.) during storage

Sanjay Babu, CL Maurya, Sarvendra Kumar, Anil Kumar, Rajeev Kumar, Yogesh Kumar, Rohit Yadav, Ajay Pratap Singh, Yogendra Pratap Singh and Narang Kapoor

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Abstract
A comparative study of botanicals and novel molecules on storability of mungbean {*Vigna radiata* (L.) Wilzeck} was carried out in Complete Randomized Design in Laboratory under ambient storage condition with four replications with an objective to assess the effect of various treatments on seed quality and vigour attributes. The experiment was conducted in the laboratory of department of Seed Science and Technology, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur during 2023-25. Twelve treatments including control were tested and evaluated on freshly harvested mungbean seeds of variety 'Shweta'. The result obtained indicated that various treatments gave significantly better results as compared to control for all the seed quality parameters studied. In the result it was found that among the tested seed protectants, Broflanilide @ 1 ppm (300 SC) @ 3.33 mg/kg seed gave most promising results for various seed quality attributes such as standard germination, shoot length, root length, seedling length, seedling dry weight, speed of germination and vigour under ambient storage period. Thus, Broflanilide @ 1 ppm may be recommended to the farmers for safe storage of mungbean seeds without losing seed viability and vigour up to 12 months.

Keywords: Standard germination, seedling length, seedling dry weight, vigour index, broflanilide

Introduction

Mungbean is scientifically recognized as (*Vigna radiata* L.) belongs to the family Leguminosae and sub family Papilionaceae with chromosome number 2n = 22, which is closely related to adzuki and cowpea. Mungbean is native of India and central Asia, Vavilov (1926) [11]. Which grown in these area since prehistoric times. It is now spreading in many other Asian and African countries Mungbean crop is major pulse crops of many Asian countries including India, where the diet is mostly cereals based. Mungbean is widely cultivated throughout the Asia, including Pakistan, Bangladesh, Sri Lanka, Thailand, Cambodia, Vietnam, Indonesia, Malaysia and China. It is also grown in the many parts of Africa and USA and recently has been introduced in Australia. In India, mungbean crop grown as third most important pulse crop and also known as green gram. It is grown about more than 4.6 m ha in the country mainly in Rajasthan, Maharashtra, Madhya Pradesh, Karnataka, Orissa, Bihar, Tamilnadu, Gujarat, Andhra Pradesh, Telangana and others. In world, India is the largest pulses producer and consumer. It is good source of vegetable protein. Mungbean contains about 23.9% protein, which is rich in lysine. Mature cooked seed form a valuable constituent of diet of considerable number of people in country. The green pods of mungbean are eaten as vegetable whereas, mature seed serve as a source of pulse, which is an important of diet in Indian subcontinent. It is esteemed as food as it does not produce heaving and flatulence. It is also used as a light diet administered during fever and considered to have a cooling and astringent effect. The flour of mungbean is used as excellent substitute of soap for cleaning the body.

Production and maintenance of seed quality are the significant aspects of seed industry. Thus, the maintenance of seed quality is equally important as production of quality seed. Decline in viability and seed vigour has been reported during storage.

Plant protection chemicals are considered as an adjustment to modern agriculture, but the marginal status of pulses has not encouraged the pulse growers for effective use of these chemicals. There has been considerable development in the bio control of plant insect during eighties. Within the frame work of Integrated Pest Management (IPM) system, bio control of the pest of pulse storage can be successfully exploited, however, it is yet to get momentum. Pulse crops have a unique position in sustainable crop production. The insect pest causing economic losses on pulse are many; some of them are in wide occurrence and some are localized in nature. The annual yield losses has been estimated to about 15% in chickpea, 20% in pigeon pea and 30% in urd and mung bean on an average of 2.5-3.0 million tonnes of pulses are lost annually due to pest problems. The major bio control attempts have been targeted against *Callosobruchus chinensis*. Seed treatment provides a good assurance against diseases, pests and produces normal seedlings that improve the germination of seed through control of internal and external seed infection. Mung bean is short lived and it is stored under ambient conditions till the next sowing season. For safe seed storage, the suitable recommended packaging material for mung bean is still not available to the farmers. Hence, an attempt has been made to find out the suitable and cheapest storage conditions for maintaining seed viability and vigour from harvest to next planting season. In order to maintain the seed quality during ambient storage which is deteriorated by infestation of bruchids is managed by using seed protectants insecticides and botanicals which arrest the bruchids life cycle during ambient storage. The use of common contact insecticides as seed protectants such as Emamectin benzoate, Spinosad, etc, can maintain the seed germination, viability and vigour (Patil *et al.*, 2006) [6]. Another, after several technological advancement of seed, we have not been able to maintain seed quality products due to insect pest infestation during storage. Post-harvest losses due to insect-pests which increasing year to year. Eco-friendly seed protectants as known to fend the feeding and breeding of insects in various ways in addition to causing direct mortality. Many farmers also use the different seed protectants *viz.*, Neem extracts product, vegetative oil and various species of plants. Which have been found to provide adequate protects for long storage period against pulse beetle (*Callosobruchus chinensis* L.) (Golob and Webley, 1980) [4]. With the advancement of science, novel molecules are needed to be identified for precise control of bruchids with reduced harming to human health. Keeping the above facts in consideration the present investigation was carried out to assess the efficacy of botanicals and novel molecules on seed quality of mungbean seeds during ambient storage conditions.

Materials and Methods

The experiment was conducted in laboratory of department of Seed Science and Technology, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur during 2023-25. The experiment comprised of twelve treatments viz., T_1-Neem Seed Kernel Powder @ 5 gm/kg, T_2-Neem oil @ 5 ml/kg, T_3-Eco Neem plus @ 5 ml/kg, T_4-Broflanilide @ 1 ppm (300 SC) 3.33 mg/kg, T_5-Broflanilide @ 2 ppm (300 SC) 6.66 mg/kg, T_6-Broflanilide @ 3 ppm (300 SC) 9.99 mg/kg, T_7-Dinotefuran @ 1 ppm (20 SG) 5 mg/kg, T_8-Dinotefuran @ 2 ppm (20 SG) 10 mg/kg, T_9-Dinotefuran @ 3 ppm (20 SG) 20 m/kg, T_{10}.Emamectin benzoate @ 2 ppm (5 SG) 40 mg, T_{11}-Deltamethrin @ 1 ppm (2.8 EC) 0.04 ml/kg, T_{12}-Control. The seeds of mungbean varietiy 'Shweta' were disinfested before start the experiment. These seeds were kept at least one week in the laboratory under ambient conditions. One kg of freshly harvested seed with very high percentage of germination and low moisture content (<10%) was taken for each treatment for experiment. For seed treatments with the required quantity of pesticides were diluted in water to make total volume of 5 ml for treating 1 kg of seed for proper coating. After drying in shade, seeds were packed and kept in room under ambient temperature. The temperature and relative humidity of the room was recorded on standard weekly basis. The data collected during the course of investigation was pooled and subjected to statistical analysis by adopting appropriate method of analysis of variance. The analysis of variance of the data for each parameter was computed using the OPSTAT software.

Results and Discussion

The results obtained from the pooled data are depicted in the table 1 and table 2 and graphically represented in fig 1, fig 2 and fig 3. The data from the table clearly indicated that there was significant difference among the treatments. The highest standard germination was recorded for the treatment T_9 (95.88%) which was closely followed by T_8 (95.50%) and T_7 (95.50%) being significantly superior to control at 3 months. At 6, 9 and 12 months, the highest standard germination was recorded for the treatment T_4 (92.00%, 89.75% and 81.75%) followed by T_9 and T_5 being significantly superior to control. The highest germination showed by these treatment may be due to the reason that they were least affected by bruchids. These findings were also reported by Babu and Ravi (2008) [2], Srinath (2010) [9] and Mandali and Rani (2015). The highest shoot length (10.32, 12.62, 10.12 and 9.69 cm respectively at 3, 6, 9 and 12 months), root length (10.22, 12.61, 9.69 and 9.29 cm respectively at 3, 6, 9 and 12 months) and seedling length (20.53, 25.23, 19.80 and 18.98 cm respectively at 3, 6, 9 and 12 months) was recorded for the treatment T_4 followed by T_9. The increased shoot, root and seedling length may be attributed to the enhanced germination and vigour level. These findings are in conformity to the results reported by Tariq and Dawar (2012) [10], Yogitha (2017) [12] and Bhati (2021) [3]. The highest seedling dry weight (10 seedlings) at 3, 6, 9 and 12 months was recorded for the treatment T_4 (0.299, 0.273, 0.260 and 0.249 g respectively). These findings are in accordance to the findings reported by Babu and Ravi (2008) [2], Yogitha (2017) [12] and Bhati (2021) [3]. The highest speed of germination at 3, 6, 9 and 12 months was recorded for the treatment T_4 (41.95, 41.27, 38.16 and 32.98 respectively) followed by T_5 being significantly superior to control. The higher values of speed of germination could be attributed to the early seed germination during germination period which also led to enhanced germination. The maximum vigour index-I was recorded for the treatment T_7 (1909.13) at 3 month followed by T_9 and T_4 being significantly superior to control. However, at 6, 9 and 12 months, the maximum vigour index-I was observed with the treatment T_4 being significantly superior to control. The maximum vigour index-II at 3, 6, 9 and 12 months was recorded with the treatment T_4 (27.51, 25.08, 23.32 and 20.35 respectively) followed by T_7 being significantly superior to control. The higher values of vigour parameters may be attributed to the higher germination and improved seedling length and seedling dry weight. Similar findings have also been reported by Rajasri *et al.* (2012) [7], Babariya *et al.* (2016) [1] and Sharma *et al.* (2017) [8]. These results indicate towards the efficacy of novel insecticides such as Broflanilide and Dinotefuran in safe storage of the mungbean seeds under ambient conditions.

Table 1: Effect of botanicals and novel molecules on standard germination, shoot length, root length and seedling length of mungbean var. 'Shweta'

Treatments	Standard Germination (%)				Shoot Length (cm)				Root Length (cm)				Seedling Length (cm)			
	3 Months	6 Months	9 Months	12 Months	3 Months	6 Months	9 Months	12 Months	3 Months	6 Months	9 Months	12 Months	3 Months	6 Months	9 Months	12 Months
Neem Seed Kernel Powder	93.29	89.00	65.75	34.75	9.26	11.46	9.20	7.07	8.96	11.24	8.50	8.09	18.21	22.71	17.70	15.15
Neem oil	90.04	85.00	76.88	65.50	9.32	11.50	9.28	7.32	9.09	11.43	8.87	8.34	18.40	22.92	18.14	15.66
Eco Neem plus	91.92	86.00	81.38	70.13	9.41	11.57	9.32	7.40	9.20	11.60	8.66	8.31	18.60	23.18	17.98	15.70
Broflanilide @ 1 ppm (300 SC)	92.00	92.00	89.75	81.75	10.32	12.62	10.12	9.69	10.22	12.61	9.69	9.29	20.53	25.23	19.80	18.98
Broflanilide @ 2 ppm (300 SC)	95.13	91.29	88.00	79.63	9.80	12.20	9.71	9.21	9.83	12.16	9.27	8.84	19.63	24.36	18.98	18.05
Broflanilide @ 3 ppm (300 SC)	94.25	91.13	87.50	78.38	9.78	12.01	9.54	9.07	9.57	12.02	9.12	8.70	19.34	24.03	18.67	17.77
Dinotefuran @ 1 ppm (20 SG)	95.50	90.00	88.79	75.00	9.99	12.34	9.88	9.35	10.01	12.38	9.40	8.94	19.99	24.72	19.28	18.28
Dinotefuran @ 2 ppm (20 SG)	95.50	90.29	87.00	78.13	9.45	11.97	9.64	8.98	9.16	11.63	8.75	8.30	18.61	23.59	18.39	17.28
Dinotefuran @ 3 ppm (20 SG)	95.88	91.42	88.50	80.38	10.05	12.36	9.83	9.25	9.75	12.32	9.37	8.96	19.80	24.68	19.20	18.22
Emamectin benzoate @ 2 ppm (5 SG)	95.13	90.00	86.50	77.75	9.66	11.86	9.55	8.90	9.09	11.61	8.63	8.19	18.76	23.47	18.18	17.09
Deltamethrin @ 1 ppm (2.8 EC)	94.75	90.42	86.00	78.25	9.59	11.67	9.29	8.70	9.20	11.44	8.63	8.15	18.79	23.11	17.92	16.85
Control	91.88	81.29	59.00	31.38	9.29	11.44	9.11	6.17	8.55	11.15	8.34	7.73	17.84	22.59	17.45	13.90
SE(m)	0.605	0.524	0.762	0.534	0.063	0.074	0.052	0.046	0.079	0.080	0.056	0.061	0.115	0.106	0.079	0.079
C.D.	1.742	1.510	2.194	1.539	0.181	0.212	0.149	0.131	0.229	0.230	0.162	0.177	0.330	0.306	0.227	0.227
C.V.	1.291	1.179	1.856	1.543	1.305	1.235	1.082	1.081	1.692	1.351	1.257	1.446	1.205	0.895	0.852	0.934

Table 2: Effect of botanicals and novel molecules on seedling dry weight, speed of germination, vigour index-I and Vigour index-II of mungbean var. 'Shweta'

Treatments	Seedling Dry Weight (g)				Speed of Germination				Vigour Index-I				Vigour Index-II			
	3 Months	6 Months	9 Months	12 Months	3 Months	6 Months	9 Months	12 Months	3 Months	6 Months	9 Months	12 Months	3 Months	6 Months	9 Months	12 Months
Neem Seed Kernel Powder	0.247	0.221	0.209	0.201	40.18	37.17	29.10	13.11	1698.91	2020.74	1163.73	526.58	23.04	19.67	13.69	6.98
Neem oil	0.252	0.228	0.212	0.207	37.84	35.82	31.85	23.69	1656.69	1947.95	1394.44	1025.96	22.69	19.35	16.20	13.53
Eco Neem plus	0.256	0.233	0.220	0.211	38.79	35.58	34.29	26.35	1709.32	1993.12	1463.49	1101.07	23.53	20.03	17.87	14.77
Broflanilide @ 1 ppm (300 SC)	0.299	0.273	0.260	0.249	41.95	41.27	38.16	32.98	1888.38	2321.45	1777.08	1551.88	27.51	25.08	23.32	20.35
Broflanilide @ 2 ppm (300 SC)	0.274	0.253	0.231	0.229	38.37	37.15	33.54	30.27	1867.12	2223.39	1670.20	1437.02	26.06	23.10	20.25	18.20
Broflanilide @ 3 ppm (300 SC)	0.271	0.247	0.229	0.223	39.12	37.10	33.01	29.15	1822.91	2189.26	1633.66	1392.92	25.54	22.51	20.06	17.45
Dinotefuran @ 1 ppm (20 SG)	0.288	0.265	0.248	0.232	38.58	36.49	34.08	29.58	1909.13	2224.34	1712.05	1371.37	27.51	23.86	22.20	17.38
Dinotefuran @ 2 ppm (20 SG)	0.268	0.241	0.226	0.218	40.11	36.70	32.27	30.23	1777.16	2130.09	1599.38	1350.21	25.59	21.76	19.67	17.06
Dinotefuran @ 3 ppm (20 SG)	0.278	0.251	0.235	0.225	39.01	36.87	34.50	31.82	1899.08	2255.77	1699.21	1464.05	26.65	22.90	20.80	18.09
Emamectin benzoate @ 2 ppm (5 SG)	0.264	0.238	0.222	0.213	39.70	36.33	34.08	29.92	1784.15	2111.73	1572.62	1328.50	25.11	21.46	19.10	16.51
Deltamethrin @ 1 ppm (2.8 EC)	0.259	0.237	0.219	0.207	39.35	36.36	34.30	31.04	1780.18	2089.79	1540.68	1318.06	24.54	21.38	18.76	16.18
Control	0.227	0.210	0.205	0.196	37.49	33.79	25.37	11.89	1638.89	1836.01	1029.38	436.27	20.85	17.03	12.03	6.14
SE(m)	0.003	0.001	0.002	0.002	0.297	0.332	0.202	0.245	13.496	16.063	15.128	11.599	0.235	0.202	0.204	0.186
C.D.	0.007	0.004	0.005	0.005	0.855	0.958	0.583	0.706	38.866	46.260	43.567	33.404	0.678	0.581	0.588	0.536
C.V.	1.889	1.013	1.646	1.495	1.514	1.811	1.231	1.837	1.511	1.521	1.989	1.946	1.893	1.875	2.187	2.447

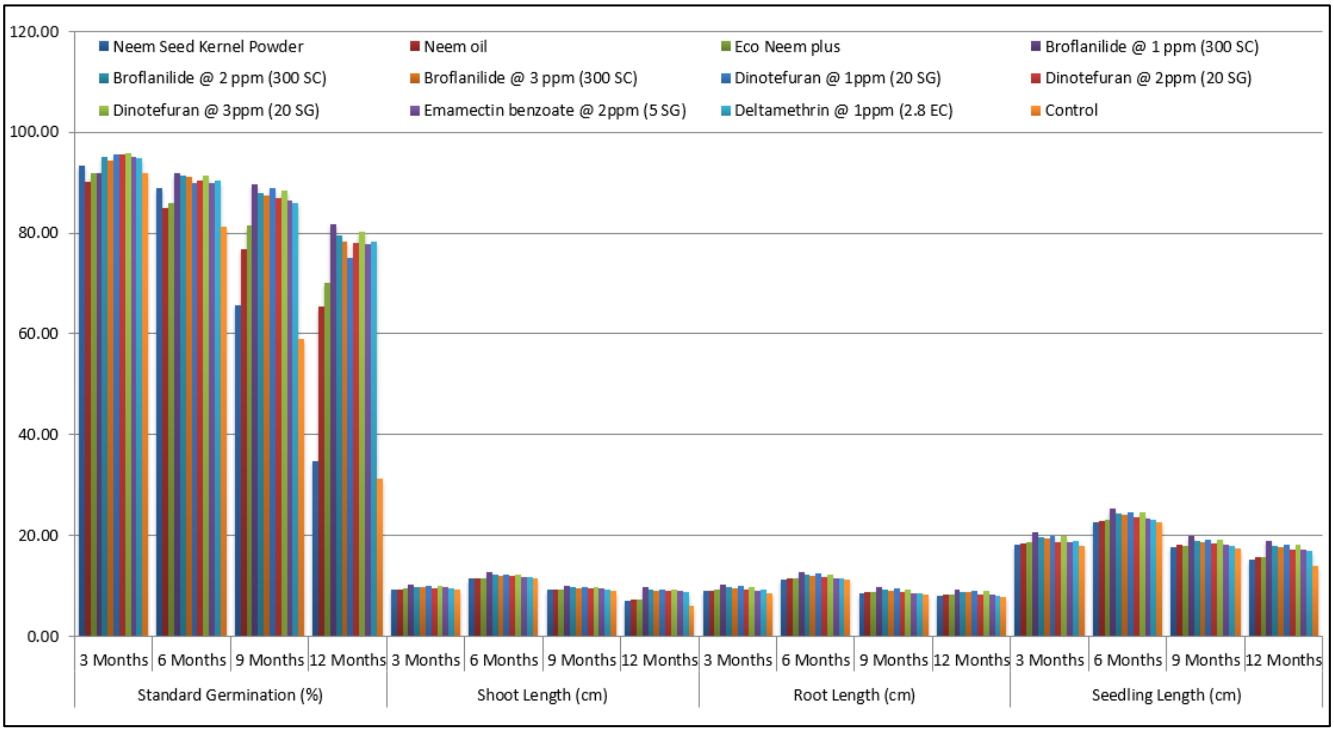

Fig 1: Graphically effect of botanicals and novel molecules on standard germination, shoot length, root length and seedling length of mungbean var. 'Shweta'

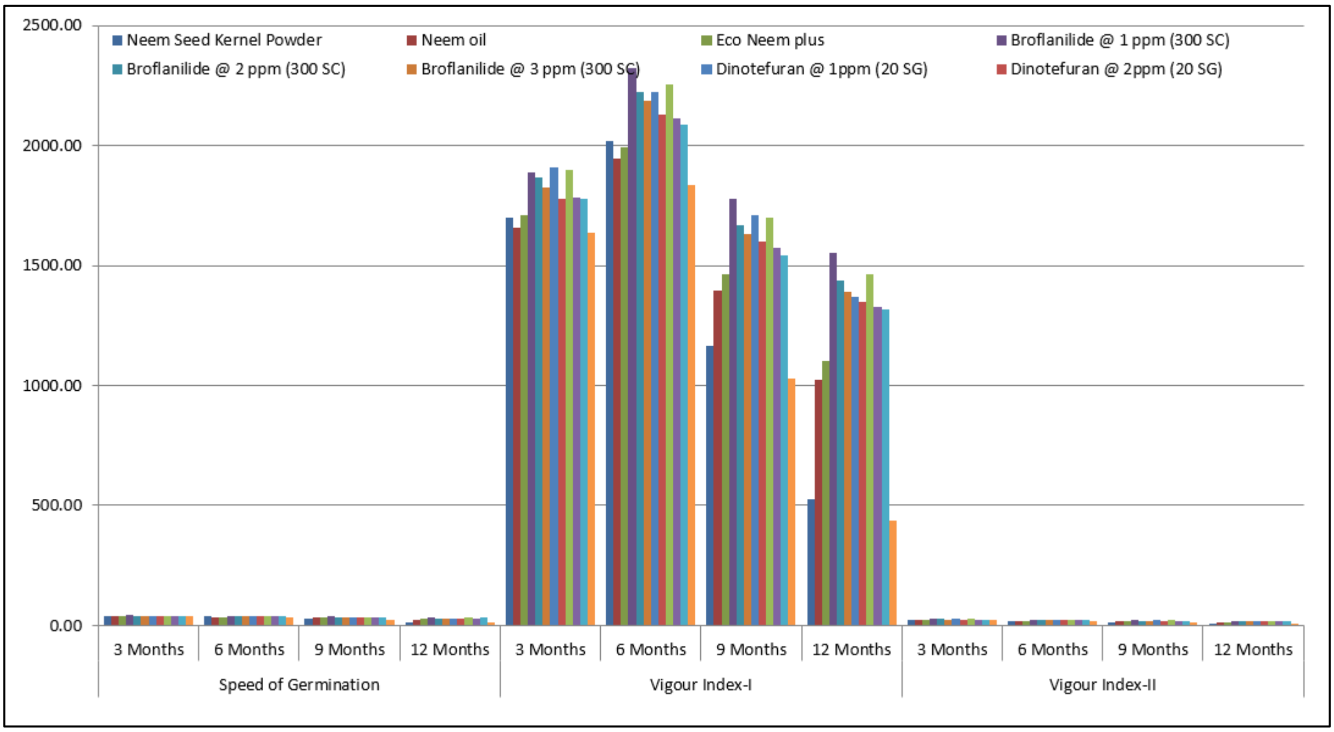

Fig 2: Graphically effect of botanicals and novel molecules on speed of germination vigour index-I and Vigour index-II of mungbean var. 'Shweta'

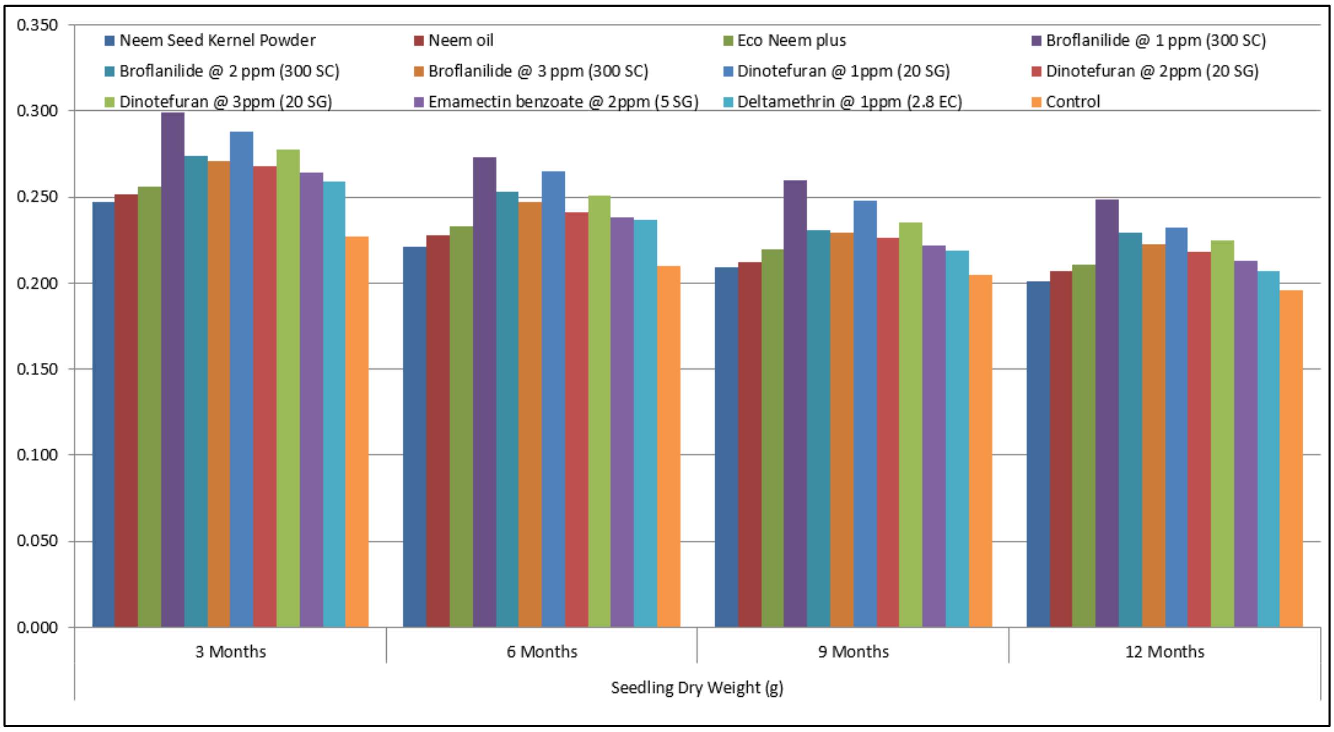

Fig 3: Graphically effect of botanicals and novel molecules on seedling dry weight of mungbean var. 'Shweta'

Conclusions

Based on the above findings, it is concluded that the treating the seeds with novel insecticides such as Broflanilide and Dinotefuran at the rate of 1 ppm will permit the farmers to store the seeds safe up to 12 months and it will also protect the seeds from the infestation of seeds from storage insect pest. Thus they can maintain the quality of seeds and get a better price in the market.

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