



INDIAN HORTICULTURE RESEARCH TRENDS: A STUDY OF PHD RESEARCHES CONDUCTED IN INDIAN UNIVERSITIES AND INSTITUTIONS

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Abstract

Horticulture is the most important in our daily living. Human body requires vitamins, minerals, proteins, energy etc. for its health and all these are supplied by horticultural crops. The significance of any field is analysed by growth of the research on that field. So, in the present study the characteristics of the theses on horticulture from 1952 to 2017 in India have been explored. The data was obtained from the IndCat and analysed on the various parameters such as publishing universities, paper growth, most productive department, advisor productivity, keywords/subject used. The data consist of 1594 theses, among which the most of the contributions was from Himachal Pradesh and University at the top was Dr Y S Parmar University of Horticulture and Forestry. The top three departments are Horticulture, Agricultural and Vegetable Crop with 1092 theses.

Keywords: Horticulture, agriculture, bibliometric analysis, IndCat. Indian universities

Introduction

The word 'Horticulture' is consequential of two Latin word 'hortus' meaning garden and 'cultura' meaning cultivate (Subbarayudu). The term 'Horticulture' comes in presence in seventeenth century (Kumar and Dwivedi, 2018a; Kumar *et al.* (2018b); Kumar *et al.*, 2018c; Kumar and Dwivedi, 2018d; Kumar *et al.*, 2018e; Kumar and Pathak, 2019f; Kumar *et al.*, 2019g). To ensure the food security, there is need of research on horticulture crops as it can feed the hunger of the coming generation. It's worth to mention that in India horticultural crops have a good accountability. This includes fruits, nuts, vegetables, root, flowers, ornamental plants, medicinal and aromatic plants, spices, condiments etc (Anonymous, Ganeshamurthy). Thus, looking to the importance of the field, a significant effort has been made to reconnoitre the Online Union Catalogue of Indian Universities (Indcat) for collecting the entire Ph.D. thesis related to Horticulture and applying bibliometric analysis to recognize information trends and innovations on the areas of horticulture (Siddique and Kumar, 2018h; Siddique *et al.*, 2018i; Pathak *et al.*, 2017j; Prakash and Kumar, 2017k; Kumar and Mandal, 2014L; Kumar *et al.*, 2014m; Kumar *et al.*, 2014n; Kumar, 2013o; Kumar and Dwivedi, 2015p; Gogia *et al.*, 2014q).

Literature Review

Leiser *et al.* conducted the analysis of hypothetical literature on fruits and vegetables using bibliometrics tools and techniques for the period of 2000-2006. They focused on both quantitative and qualitative indicators. They obtained the data from the WOS and used Sphinx data processing program for analysing the data. They concluded that there was 1463 articles, and out of which the "fruit and vegetable corps" were only 8% (Kumar, 2014r; Kumar *et al.*, 2012s; Mishra *et al.*, 2012t; Kumar *et al.*, 2011u; Kumar *et al.*, 2011v; Kumar and Pathak, 2016w; Pathak *et al.*, 2016x). Tunga conducted bibliometrics study of Journal citations in

horticulture doctoral dissertations for period of 1991-2010. He determined that first 9 subject zones cover 25.69 percent of the total journal citations. And half-life of journal citations by scientists are calculated as (Median year) 24 years. World research output on horticulture science has been evaluated by Bangara Chaluvaiiah *et al.* using bibliometrics techniques. They concluded that a total 3074 papers were published in span of 1989-2016. They obtained the data from the secondary sources and evaluated in terms of distribution of publication, year wise distribution, most prolific authors published in horticultural science, country wise distribution of publication, top funding agency for publication of horticultural science, top horticultural science publication in various research areas and organisational contribution to horticultural science publication (Kumar and Harsavardhn *et al.*, 2018y; Kumar *et al.*, 2018z; Kumar *et al.*, 2018aa; Kumar *et al.*, 2018bb; Kumar *et al.*, 2018cc; Singh *et al.*, 2020a; Singh *et al.*, 2020b; Sood *et al.*, 2020; Bhadrecha *et al.*, 2020; Singh *et al.*, 2020c; Sharma *et al.*, 2020; Singh *et al.*, 2020d; Bhati *et al.*, 2020; Singh *et al.*, 2019; Sharma *et al.*, 2019). Mohan Brij *et al.* conducted bibliometrics study on remote sensing and GIS. They found 365 theses were comprising for time periods of 1985-2016 from Indcat, they analysed the data on the various parameters such as University, State, Subject heading etc. The top contributor university were Andhra University and top three departments are geology, geography and physics with 124theses. Kolle *et al.* conducted bibliometric analysis of 781 highly cited articles on horticulture from 1961-2014. They concluded that "The Journal Theoretical and Applied Genetics" and "American Journal of Enology and Viticulture" were more productive journals. USA and the UK were the topmost countries. The study on the Agri-food supply chain (ASC) have been conducted by Jianli Luo *et al.* using the bibliometric stools. They found that there were 1770 articles in Scopus. They concluded that Wageningen University and Research Centre have maximum contribution, followed by Michigan State University, and Cardiff University. And 5985

keywords from 1770 paper were found and among these the top keywords were Supply chain, food, agriculture, and value chain. The growth of Indian research in bio physics have been presented by Munjal *et al* using bibliometrics tools. They extracted data from online union catalogue of Indian Universities. The data extracted was consisting of 4,36,967 Ph.D theses from 317 universities. The majority contribution is from west Bengal followed by Karnataka.

Methodology

The doctorate theses represent the maximum degree of scientific and speculative expression and are the most reputed and appreciated foundation of data. The analysis of these is very imperative so, the keyword Horticulture was searched in Online Union Catalogue of Indian Universities (Indcat). After removing the duplicity, the relevant database was created which consist of 1595 theses from 1952 to 2017 and MS excel was used for analysing the data on the basis of University, State, Subject heading etc. The analysis of keywords has been done by VOS viewer.

Results and Discussion

Table 1 presents decade wise contribution of Indian research in the field of horticulture from 1952 to 2017, there are 1594 theses consisting keyword 'Horticulture'. Among these, determined studies have been done in 1978-1987 followed by 1988-1997. This presents that horticulture as a keyword became prevalent amongst the research scholars after 1968 as primarily only few researches had been done in this area but after a year 1968 a constant growth had been detected. The given table reflects that people had slowly gained their interest in therefore the growth rate studies which had been conducted in this area has increased. But in

span of 2008-2017 the growth was sliding which is pointing towards some challenges in this area.

Table 1: Decade wise growth and development of the doctoral theses in horticulture.

Year		Fre Que ncy	Cum. Fre. (Arti cles)	Year Span	Cum. Fre. (ye ars)	Gro wth Rate
From	To					
1952	1957	2	2	6	6	0.33
1958	1967	2	4	10	16	0.25
1968	1977	144	148	10	26	5.69
1978	1987	520	668	10	36	18.56
1988	1997	387	1055	10	46	22.93
1998	2007	364	1419	10	56	25.34
2008	2017	168	1587	10	66	24.05
Year not Mention		7	1594			

Figure 1 gives the state wise contribution. It's worth to note that the contributions are from 27 states. The majority of the contributions are from 'Himachal Pradesh' with 443 contributions (27.79%) followed by 'Uttar Pradesh' with 352 contributions (22.08%), 'Maharashtra' with 122 contributions (7.65 %). Figure 1 clearly depicts that contribution is from all the zones, i.e, north, south, east, west and central part of the country. North zone is at the top in terms of researches with 69.3% theses of the total. This clearly reflects the region which has more focus on the farming and researchers are also exploring more tools and the ways of improving the same. The North east part of the India has only 2.3 % contribution, there is a scope of improvement

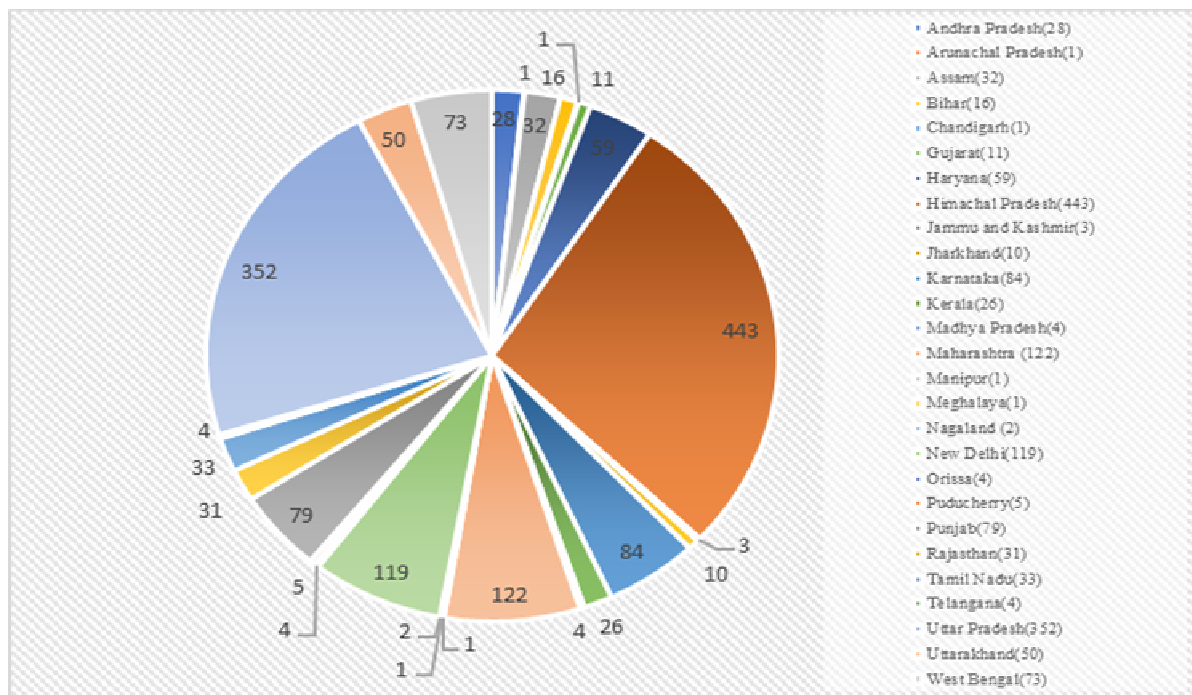


Fig. 1: State wise contrition of thesis in the field of horticulture by Indian Scholars

Table 2 presenting top 12 universities name, state of the university, number and the percentage of the thesis contributed. It is notable that top four university were from North. Dr Y S Parmar University of Horticulture and Forestry contributed 26.41% and got 1st rank followed by

Banaras Hindu University, Uttar Pradesh and Indian Agricultural Research Institute, New Delhi, it is worth to note that there are 77 universities in India contributing in Horticulture. thus Horticulture has attracted the researchers all over the India.

Table 2: Top rank universities contribution on horticulture.

Rank	Name of university	State	No. of contribution	Percentage
1	Dr Y S Parmar University of Horticulture and Forestry	Himachal Pradesh	421	26.41
2	Banaras Hindu University	Uttar Pradesh	171	10.73
3	Indian Agricultural Research Institute	New Delhi	100	6.27
4	Punjab Agricultural University	Punjab	77	4.83
5	University of Agricultural Sciences	Karnataka	67	4.20
6	Chhatrpati Shahu Ji Maharaj University	Uttar Pradesh	64	4.02
7	Ch Charan Singh Haryana Agricultural University	Haryana	58	3.64
8	Mahatma Phule Krishi Vidyapeeth	Maharashtra	54	3.39
9	G.B. Pant University of Agricultural and Technology	Uttarakhand	49	3.07
10	Bidhan Chandra Krishi Vishwavidyalaya	West Bengal	38	2.38
11	Marathwada Agricultural University	Maharashtra	32	2.01
12	Assam Agricultural University	Assam	31	1.94
12	University of Calcutta	West Bengal	31	1.94

In terms of prolific supervisor top three are from Uttar Pradesh and majority of top supervisors are also from Uttar Pradesh followed by Himachal Pradesh. Prasad A is top rank supervisor with 18 theses followed by R P Singh, D B Singh, U VSulladmath with contribution of 16, 14, 14 respectively. Total 1393 theses were guided by 607 supervisors.

Table 3: Top research supervisors of horticulture along with contribution and affiliation.

Name of guide	Contribution	Percentage	Affiliation	State
Prasad A	18	1.29	Chhatrpati Shahu Ji Maharaj University-11, Chandra Shekhar Azad University of Agricultural and Technology -7	Uttar Pradesh
Singh R P	16	1.15	Chhatrpati Shahu Ji Maharaj University-1, Govind Ballabh Pant University of Agricultural and Technology-14, Narendra Deva University of Agriculture and Technology-1	Uttar Pradesh, Uttarakhand
Singh D B	14	1.01	Allahabad Agricultural Institute	Uttar Pradesh
Sulladmath U V	14	1.01	University of Agricultural Sciences-9, Bangalore University-5	Karnataka
Bose T K	12	0.86	Bidhan Chandra Krishi Vishwavidyalaya	West Bengal
Bajpai P N	10	0.72	Chandra Shekhar Azad University of Agricultural and Technology-4, Chhatrpati Shahu Ji Maharaj University-6	Uttar Pradesh
Maurya A N	10	0.72	Banaras Hindu University	Uttar Pradesh
Seshadri V S	10	0.72	Indian Agricultural Research Institute	New Delhi
Sharma P P	10	0.72	Dr Y S Parmar University of Horticulture and Forestry-9, Ch Sarwan Kumar Himachal Pradesh Krishi Vishwavidyalaya-1	Himachal Pradesh
Awasthi R P	9	0.65	Dr Y S Parmar University of Horticulture and Forestry	Himachal Pradesh
Khosla P K	9	0.65	Dr Y S Parmar University of Horticulture and Forestry	Himachal Pradesh
Korla B N	9	0.65	Dr Y S Parmar University of Horticulture and Forestry	Himachal Pradesh
Roy S K	9	0.65	Indian Agricultural Research Institute-8, Banaras Hindu University-1	New Delhi/Uttar Pradesh
Sharma R K	9	0.65	Chhatrpati Shahu Ji Maharaj University	Uttar Pradesh
Sharma Y D	9	0.65	Dr Y S Parmar University of Horticulture and Forestry	Himachal Pradesh
Singh B P	9	0.65	Banaras Hindu University	Uttar Pradesh

Table 4 presents the top 18 departments are working in the areas of horticulture. The top four disciplines are Horticulture, Agricultural, Vegetable Crop and Agronomy with 872, 145, 75, and 48 contributions respectively. It is important to note that 89 departments contributed in Horticulture which is a huge number. Decade wise growth of

the top 4 departments has been presented in Figure 2. The top four keywords came into existence in the decade 1968-1977. In decade 1978-1987 the keywords 'Horticulture', 'Vegetable Crop' and 'Agronomy' occurred maximum times i.e. 344, 35, 27 respectively.

Table 4: Rank list of departments contributions on horticulture.

Rank	Department	Citation	Percentage
1	Horticulture	872	54.71
2	Agricultural	145	9.1
3	Vegetable Crop	75	4.71
4	Agronomy	48	3.01
5	Entomology	29	1.82
6	Biotechnology	24	1.51
6	Mycology and Plant Pathology	24	1.51
6	Plant Pathology	24	1.51
7	Pomology	23	1.44
8	Botany	17	1.07
8	Post -Harvest Technology	17	1.07
8	Vegetable Science	17	1.07
9	Entomology and Apiculture	16	1
9	Floriculture and landscaping	16	1
10	Forestry	13	0.82
10	Silviculture	13	0.82
11	Floriculture	12	0.75
11	Food Culture and orchard Management	12	0.75

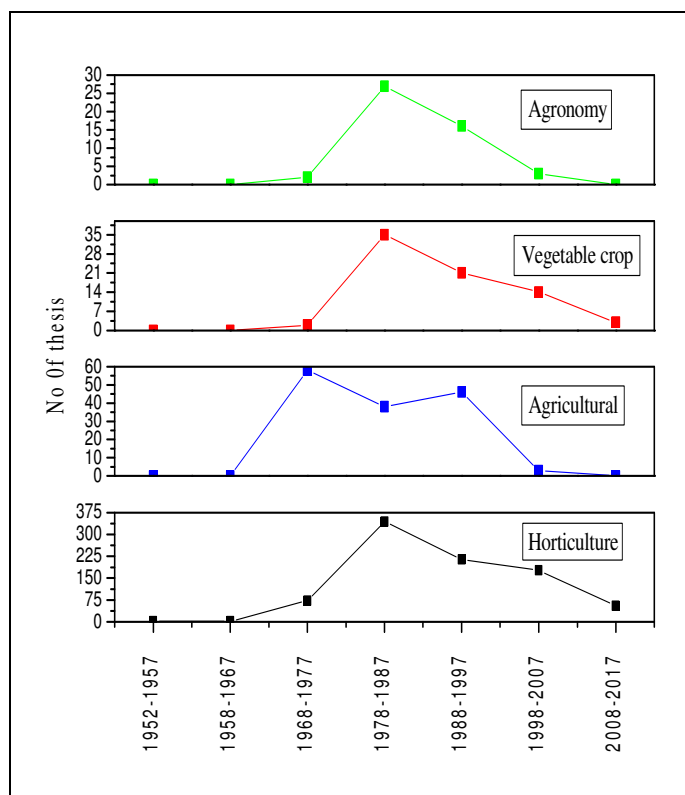


Fig. 2: Decade wise top four departments growth

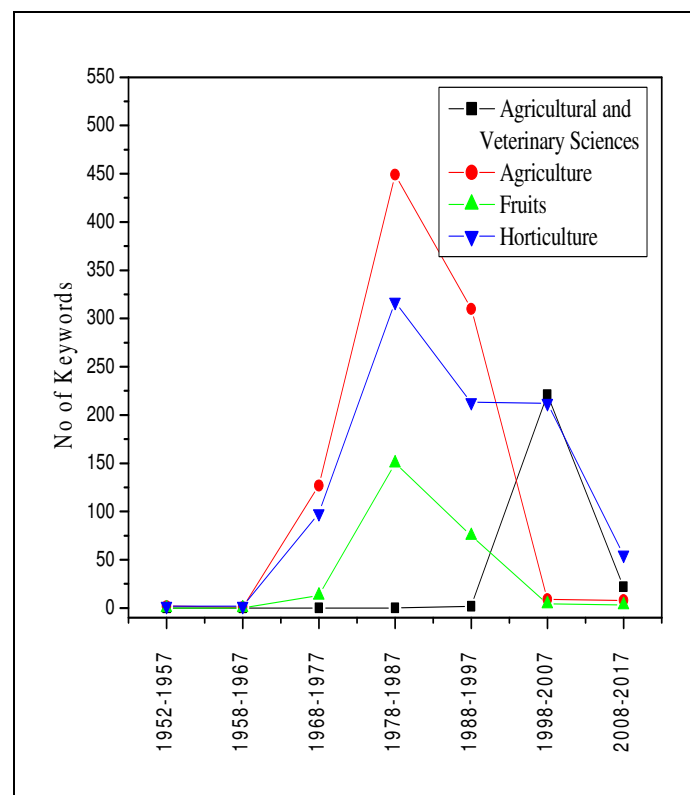


Fig. 3: Decade wise growth of top rank keywords

Figure 3 presenting the growth of top 4 keywords decade wise. Agriculture is in top with 908 occurrences followed by horticulture, fruits, agricultural and veterinary science with 904, 246 and 245 occurrences respectively. Overall, it's seen that the top three keywords have started increasing after the year 1968. The keyword 'Agricultural and Veterinary Sciences' has shown sudden jump in the decade 1998-2007.

Figure 4 gives the co-occurrence of the keywords using VOS viewer, its presents the keywords which are occurred 15 or more times. The visualization shows that a good diversity of terms. The terms most frequently used are horticulture and agriculture. In general, a first interpretation of the figure is that there is a clear orientation between Horticulture and Agriculture. The closeness of the keywords signifies that these terms co-occur quite frequently.

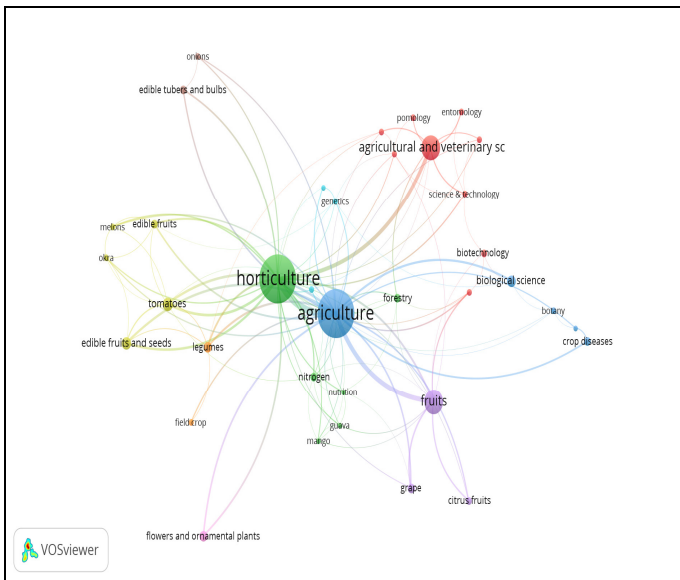


Fig. 4: Co-occurrence of keywords with minimum threshold 15 and 36 links

Conclusion

In the present economy of the world and within each nation, horticulture is an elementary industry. It is a central source of the food supply of the world. Horticulture is a part of an agricultural science which emphasis on the production, utilization and upgrading of plants. The work on horticulture is going on all over the India but still there are many flaws and there is good scope of research. Moreover, the work on horticulture is endless as it has to upgrade with time for better production. Hence, Horticulture is an art as well as science and there is a lot of scope of growing.

References

- Anonymous (2009) FAO's director-general on how to feed the world in 2050. *Popul Dev Rev.* 35: 837-839.
- Bangara, C.; Giddaiah, D. and Jagadeesha, B.M. (2016). Bibliometric study of world research output on horticulture science during 1989-2016. *e-Library Science Research Journal.* 4(10): 1-7.
- Bhadrecha, P., Bala, M., Khasa, Y.P., Arshi, A., Singh, J. and Kumar, M. (2020). *Hippophae rhamnoides* L. rhizobacteria exhibit diversified cellulase and pectinase activities. *Physiology and Molecular Biology of Plants.*
- Bhati, S., Kumar, V., Singh, S. and Singh, J. (2020). Synthesis, Characterization, Antimicrobial, Anti-tubercular, Antioxidant Activities and Docking Simulations of Derivatives of 2-(pyridine-3-yl)-1H-benzo[d]imidazole and 1,3,4-Oxadiazole Analogy. *Letters in Drug Design & Discovery.*
- Ganeshamurthy, A.N. and Satisha, G.C. (2012). Sulphur nutrition of horticultural crops. *Indian J Fertil.* 8:124-134.
- Gogia, N., Kumar, P., Singh, J., Rani, A. Sirohi, Kumar, P. 2014q. "Cloning and molecular characterization of an active gene from garlic (*Allium sativum* L.)" *International Journal of Agriculture, Environment and Biotechnology*, vol.7 (1), pp.1-10.
- Kasal, Y.G.K.; Shete, P. and Gore, A. (2017) Impact of agricultural mechanization on small holding rural population. *Indian Agriculturist.* 61(3 & 4) :187-197.
- Khan, A.A. and Farhan, M. (2013) Biotechnology and Agricultural Development. *Integral Review- A Journal of Management.* 6(2): 201350-58.
- Kolle, S.R.; Shankarappa, T.H. and Ho, Y.S. (2017). Highly cited articles in science citation index expanded - subject category of horticulture: a bibliometric analysis. *Erwerbs-Obstbau.* 59(2): 133-145.
- Kumar, P. 2013o. "Cultivation of traditional crops: an overlooked answer. *Agriculture Update*, vol.8 (3), pp.504-508.
- Kumar, P. Pathak, S. 2019f. "Responsiveness index of sorghum (*Sorghum bicolor* (L.) Moench) grown under cadmium contaminated soil treated with putrescine and mycorrhiza" *Bangladesh J. Bot.* vol.48 (1).
- Kumar, P. Purnima et al., 2018e. "Impact of Polyamines and Mycorrhiza on Chlorophyll Substance of Maize Grown under Cadmium Toxicity" *International Journal of Current Microbiology and Applied Sciences*, vol. 7(10), pp. 1635-1639.
- Kumar, P. Siddique, A. et al., 2019g. "Role of Polyamines and Endo-mycorrhiza on Leaf Morphology of Sorghum Grown under Cadmium Toxicity" *Biological Forum – An International Journal.* vol.11 (1) pp. 01-05.
- Kumar, P., Kumar, P.K., Singh, S. 2014n. "Heavy metal analysis in the root, shoot and a leaf of psidium guajava l. by using atomic absorption spectrophotometer" *Pollution Research*, .33 (4) pp.135-138.
- Kumar, P., Mandal, B., Dwivedi P., 2014m. "Phytoremediation for defending heavy metal stress in weed flora" *International Journal of Agriculture, Environment & Biotechnology*, 6(4), pp. 587-595.
- Kumar, P., 2014r. "Studies on cadmium, lead, chromium, and nickel scavenging capacity by in-vivo grown *Musa paradisiacal.* using atomic absorption spectroscopy" *Journal of Functional and Environmental Botany*, vol.4(1), pp.22-25.
- Kumar, P., Dwivedi, P. 2015p. "Role of polyamines for mitigation of cadmium toxicity in sorghum crop" *Journal of Scientific Research*, B.H.U., 59, pp.121-148.
- Kumar, P., Dwivedi, P., Singh, P., 2012s. "Role of polyamine in combating heavy metal stress in stevia rebaudiana Bertoni plants under in vitro condition" *International Journal of Agriculture, Environment and Biotechnology*, 5(3) pp.185-187.
- Kumar, P., Harsavardhn, M. et al., 2018y. "Effect of Chlorophyll a/b ratio in Cadmium Contaminated Maize Leaves Treated with Putrescine and mycorrhiza" *Annals of Biology* 34(3)-281-283.
- Kumar, P., Krishna, V., et al., 2018cc. "Assessment of Scavenging Competence for Cadmium, Lead, Chromium and Nickel Metals by in vivo Grown *Zea mays* L. using Atomic Absorption Spectrophotometer, *Annals of Ari-Bio Research*, 23(2): 166-168.
- Kumar, P., Kumar, S. et al., 2018bb. "Evaluation of Plant Height and Leaf Length of Sorghum Grown Under Different Sources of Nutrition" *Annals of Biology*, 34(3): 284-286.
- Kumar, P., Mandal, B., 2014L Dwivedi, "Combating heavy metals toxicity from hazardous waste sites by harnessing scavenging activity of some vegetable plants" *vegetos*, vol.26(2), pp. 416-425.
- Kumar, P., Mandal, B., Dwivedi, P. 2011u. "Heavy metal scavenging capacity of *Mentha spicata* and *Allium cepa*" *Medicinal Plant-International Journal of*

- Phytomedicines and Related Industries* vol. 3(4) pp. 315-318.
- Kumar, P., Mandal, B., Dwivedi, P. 2011v. "Screening plant species for their capacity of scavenging heavy metals from soils and sludges. *Journal of Applied Horticulture*, 13 (2), 144-146.
- Kumar, P., Pandey, A.K., *et al.*, 2018aa. "Phytoextraction of Lead, Chromium, Cadmium, and Nickel by Tagetes Plant Grown at Hazardous Waste site" *Annals of Biology*, 34(3): 287-289.
- Kumar, P., Pathak, S. 2016w. "Heavy metal contagion in seed: its delivery, distribution, and uptake" *Journal of the Kalash Sciences, An International Journal*, 4(2), 65-66.
- Kumar, P., Yumnam, J. *et al.*, 2018z. "Cadmium Induced Changes in Germination of Maize Seed Treated with Mycorrhiza" *Annals of Agri-Bio Research*, 23(2); 169-170.
- Kumari, P.; Thaneshwari and Rahul (2018). Embryo Rescue in Horticultural Crops. *Int. J. Curr. Microbiol. App. Sci.* 7(6) :3350-3358.
- Leiser, *et al.* (2009) Tools for producing indicators from a bibliometric study of scientific production: the case of fruit and vegetable publications by the French National Institute for Agricultural Research (INRA). *Fruits*. 64(5):305-312.
- Luo, J *et al.* (2018) Agri-food supply chain management: bibliometric and content analyses. *Sustainability*.10(5):1573.
- Mishra, P.K., Maurya, B.R., Kumar, P. 2012t. "Studies on the biochemical composition of *Parthenium hysterophorus* L. in different season" *Journal of Functional and Environmental Botany*, 2(2): 1-6.
- Munjal, N.; Singh, S.; Majumdar, A.D. and Rizal, G. (2019) Biophysics Research Trends in India: Special Reference to Indian Universities. *International Journal of Innovative Technology and Exploring Engineering (IJITEE)*, 9(1): 508-511.
- Murali, R.S.; Rao, G.N.; Basavaraju, R. (2016). Liquid Chromatography Coupled to Mass Spectrometry based identification of Elite Chemotypes of *Adhatoda vasica* Nees for Profitable Agronomy - A Farmer Centric Approach. *Indian Journal of Science and Technology*. 9(26): 1-9.
- Pathak, S., Kumar, P., Mishra, P.K., Kumar, M. 2016x. "Plant-based remediation of arsenic-contaminated soil with special reference to sorghum- a sustainable approach for a cure". *Journal of the Kalash Sciences, An International Journal*, 4(2): 61-65.
- Pathak, S., Kumar, P., P.K Mishra, M. Kumar, 2017j. "Mycorrhiza assisted approach for bioremediation with special reference to biosorption", *Pollution Research*, Vol. 36(2).
- Prakash, A., P. Kumar, 2017k. "Evaluation of heavy metal scavenging competence by in-vivo grown *Ricinus communis* L. using atomic absorption spectrophotometer" *Pollution Research*, vol.37(2), pp.148-151.
- Sachin, Sharad. Kumar, Subash. Jawla and Kumar Teshu (2019) The Scenario of Agricultural Marketing in India- A Review. *Plant Archives*. 19(1): 125-130.
- Sharma, M., Singh, J., Chinnappan, P., and Kumar, A. (2019). A comprehensive review of renewable energy production from biomass-derived bio-oil. *Biotechnologia* 100(2):179.
- Sharma, R., Jasrotia, K., Singh, N., Ghosh, P., Sharma, N.R., Singh, J., Kanwar, R. and Kumar, A. (2020). A Comprehensive Review on Hydrothermal Carbonization of Biomass and its Applications. *Chemistry Africa*, 3(1):1-19
- Siddique, A. Kumar, P. 2018h. "Physiological and Biochemical basis of Pre-sowing soaking seed treatments-An overview" *Plant Archive*, 18(2), pp. 1933-1937.
- Siddique, A., Kandpal, G., Kumar P. 2018i. "Proline accumulation and its defensive role under Diverse Stress condition in Plants: An Overview" *Journal of Pure and Applied Microbiology*, vol.12 (3) pp.1655-1659.
- Singh, A.; Kumar, A. and Pramanik, T.A. (2013) Theoretical Approach to the Study of Some Plant Extracts as Green Corrosion Inhibitor for Mild Steel in HCl Solution. *Orient J Chem*. 29(1) :277-283.
- Singh, B.M. Singh, H. P. and Singh, S. (2017) Education research and practice in remote sensing and GIS: a study of PhD researches conducted in Indian Universities and Institutions from 1980 to 2016. *International Journal of Applied Business and Economic Research*. 15(21 part 2): 509-519.
- Singh, Gursharan *et al.* (2014) Potential of Chitinases as a Biopesticide against Agriculturally Harmful Fungi and Insects. *Research and Reviews: Journal of Microbiology and Biotechnology*. 3(1) Jan-Mar :27-32
- Singh, Ripudaman and Behl, Anil (2017) Regional Disparities in Levels of Agricultural Development in Punjab: A Block Level Study. *Punjab Geographer*. 13 :91-102.
- Singh, S., Kumar, V. and Singh, J. (2019). The effects of Fe(II), Cu(II) and Humic Acid on biodegradation of atrazine. *Journal of Environmental Chemical Engineering*, 8: 103539.
- Singh, S., Kumar, V., Datta, S., Dhanjal, D.S., Sharma, K., Samuel, J. and Singh, J. (2020). Current advancement and future prospect of biosorbents for bioremediation. *Science of the Total Environment*, 709, 135895.
- Singh, S., Kumar, V., Datta, S., Wani, A.B., Dhanjal, D.S., Romero, R. and Singh, J. (2020). Glyphosate uptake, translocation, resistance emergence in crops, analytical monitoring, toxicity, and degradation: a review. *Environmental Chemistry*
- Singh, S., Kumar, V., Kapoor, D., Kumar, S., Singh, S., Dhanjal, D.S., Datta, S., Samuel, J., Dey, P., Wang, S., Prasad, R. and Singh, J. (2020). Revealing on hydrogen sulfide and nitric oxide signals co-ordination for plant growth under stress conditions. *Physiologia Plantarum*, 168(2): 301-317.
- Singh, S., Kumar, V., Singla, S., Sharma, M., Singh, D.P., Prasad, R., Thakur, V.K. and Singh, J. (2020). Kinetic Study of the Biodegradation of Acephate by Indigenous Soil Bacterial Isolates in the Presence of Humic Acid and Metal Ions. *Biomolecules*, 10, 433
- Singh, S.K, Singh SK, Singh S. (2018) Vegetable crops as most efficient and economical intercrops- A brief review. *Plant Archives*. 18(1) :923-929.
- Singh, Shiv (2016) Education, Research and Practice in Gandhian: a study of Ph.D researches conducted in

- Indian Universities and Institution from 1942 to 2016. University News. 56(5) :12-16.
- Sood, M., Sharma, S.S., Singh, J, Prasad, R., and Kapoor, D. (2020). Stress Ameliorative Effects of Indole Acetic Acid on *Hordeum vulgare* L. Seedlings Subjected to Zinc Toxicity. *Phyton – International Journal of Experimental Botany*, 89(1), 71-86
- Subbarayudu, S. and Sureshreddy,S. (2015) Risk management in horticulture: a case study in Anantapuramu district. *Academicia*. 5:177–186.
- Tunga,S.K. (2013) Journal citations in horticulture doctoral dissertations 1991-2010: a case study. *International Journal of Information Research*. 3(1):62-78.