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Relationship between the Profile of Soybean Growers and their Knowledge and Adoption of Liquid Biofertilizer in Marathwada Region of Maharashtra

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The study “Knowledge and adoption of liquid biofertilizers among the soybean growers” was conducted to delineate the relationship between profile of soybean growers with their knowledge and adoption of liquid biofertilizers in Parbhani district of Marathwada region of Maharashtra state. 120 respondents were randomly selected for the present study from 12 villages of 2 talukas of Parbhani district. Data were collected using a well-structured interview schedule. There were two dependent variables namely “knowledge” and “adoption” and ten independent variables. Data were analysed by using frequency, percentage, mean, standard deviation and Pearson’s coefficient of correlation. According to the profile of soybean growers, majority of the soybean growers were educated up to Middle school level (29.17%), having small land holdings (40.83%), with medium annual income (89.17%), area under soybean cultivation (71.67 %), extension contact (70.00 %), level of social participation (55.83%), economic motivation (70.00%), risk orientation (64.17%), using medium source of information (74.17%), and belonged to medium innovativeness (72.50%). According to correlation analysis, Education, Source of information and Innovativeness of soybean growers showed positive and highly significant relationship with their knowledge and adoption of liquid biofertilizer technology. Area under soybean cultivation, Extension contact, Social participation, Economic motivation, and Risk orientation of soybean growers showed positive and significant relationship with knowledge and adoption about liquid biofertilizer technology. Land holding and annual income of soybean growers showed non-significant relationship with the knowledge and adoption about liquid biofertilizer technology.

Keywords: Adoption; knowledge; liquid biofertilizers; soybean; soybean growers.

1. INTRODUCTION

Soybean (*Glycine max* L. Merrill) is a vital legume crop that plays a crucial role in human livelihoods. It is rich in high-quality protein (40%) and edible oil (20%), containing essential amino acids. Soybean also serves as a significant source of protein in livestock feed, contributing to about two-thirds of the world’s protein concentrate used in animal feed and providing 25% of the global edible oil supply. Brazil ranks first in soybean production with 121.80 million tonnes followed by United States of America (112.55 million tonnes), Argentina (48.80 million tonnes), China (19.60 million tonnes) and India (11.23 million tonnes) accounting for 34, 32, 14, 6 and 3 per cent of world production, respectively.

India ranks fourth in area with 12.12 million hectares (29.94 million acres) accounting for 8.86 per cent of the world area and fifth in production with 11.23 million tonnes in 2020-21. The major soybean growing states are Madhya Pradesh, Maharashtra, Rajasthan, Karnataka, and Telangana. According to the first advance estimates 2023-24, Government of India, soybean crop is estimated at 115.28 lakh tonnes as compared to 149.85 lakh tonnes in 2022-23. Among the states, Madhya Pradesh is leading in soybean production with 45.97 lakh tonnes followed by Maharashtra (45.74 lakh tonnes), Rajasthan (10.69 lakh tonnes), Karnataka (4.73 lakh tonnes) Gujarat (4.23 lakh tonnes) and Telangana (2.90 lakh tonnes). (Source: Soybean Outlook, January 2022, Agricultural Market Intelligence Centre, PJTSAU)

Liquid biofertilizers, derived from natural sources and enriched with beneficial microorganisms, offer a sustainable solution for enhancing soil fertility, reducing reliance on chemical inputs, and promoting eco-friendly agricultural practices. These biofertilizers can mobilize and convert unavailable nutrients into accessible forms through biological processes. For soybean cultivation, commonly used liquid biofertilizers include Rhizobium and Phosphorus Solubilizing Bacteria (PSB).

Effective application of liquid biofertilizers requires certain precautions: they should be protected from direct sunlight and stored in cool conditions. They must not be mixed with chemical inputs like insecticides, fungicides, or fertilizers. In seed treatment, treated seeds should be kept in the shade for half an hour before sowing. Ensuring soil moisture is crucial before sowing treated seeds, as dry soil can cause the death of beneficial microorganisms. Additionally, applying chemical fungicides alongside or immediately after biofertilizers can destroy the microorganisms in the biofertilizers.

Liquid biofertilizers such as Rhizophous (a mixture of Rhizobium and PSB), Azotobacter, and Bio-NPK Consortia are available for sale at ICAR's All India Network Project on Soil Biodiversity-Biofertilizers (AINP SBB) under the Department of Soil Science and Agricultural Chemistry at Vasantrao Naik Marathwada Agricultural University (VNMKV), Parbhani. These biofertilizers are recommended for soybean cultivation.

(Source: All India Network Project on Soil Biodiversity-Biofertilizers (AINP SBB), Department of Soil Science and Agricultural Chemistry, VNMKV, Parbhani)

The study was conducted with an objective to delineate the relationship between profile of soybean growers with their knowledge and adoption of liquid biofertilizers in Parbhani district of Marathwada region of Maharashtra state. This study aims to provide insights that could inform strategies to promote the widespread adoption of liquid biofertilizers and enhance the sustainability of soybean farming.

2. MATERIALS AND METHODS

The present study was conducted purposively in the Parbhani district of the Marathwada region in Maharashtra, where a considerable number of soybean growers use liquid biofertilizers. The objective was to delineate the relationship between the profiles of soybean growers and their knowledge and adoption of liquid biofertilizers. Two talukas, Parbhani and Jintur, were selected purposively from the district. From each taluka, six villages with a significant number of soybean growers using liquid biofertilizers were randomly chosen. In each village, 10 soybean growers who using liquid biofertilizers were selected randomly, making a total of 120 respondents for the study. Two dependent variables Knowledge and Adoption and ten independent variables viz., Education, Landholding, Annual Income, Area under Soybean Cultivation, Extension Contact, Social Participation, Economic Motivation, Risk Orientation, Sources of Information, and Innovativeness were selected for the study. Data were collected from respondents using an interview schedule through personal interviews. The data were analyzed using frequency, percentage, mean, standard deviation, and Pearson's coefficient of correlation.

3. RESULTS AND DISCUSSION

3.1 Profile of the Respondents

The data regarding profile of the respondents were presented in Table 1.

Table 1 revealed that majority of the soybean growers were educated up to Middle school level (29.17%), followed by 26.67 per cent respondents who were educated up to High school level. Whereas, 18.33 and 14.17 per cent respondents were educated up to primary school level and could read and write, respectively. Further, it was noticed that 6.67 per cent respondents were graduates, followed by 4.17 and 0.83 per cent who could read only and were illiterate, respectively. It is clear the majority of the respondents were educated up to Middle school level. These findings are in line with findings of Hiremath [1]. It is noticed from the Table 1 that majority (40.83 %) of respondents were small land holders followed by semi medium (30.83 %) and marginal (19.17 %) land holders. Whereas 5.00 and 4.17 per cent respondents were large and medium land holders, respectively. It is clear that majority of the respondents belonged to small land holder category. Similar findings were observed by Rempuii [2]. The distribution of respondents according to their annual income indicates (Table 1) that majority of the respondents (89.17 %) had medium level of annual income i.e.. Rs.68,875 to 3,21,541/-, 9.17 per cent of respondents had high level of annual income and 1.66 per cent of respondents had low level of annual income. The distribution of respondents according to their annual income indicates that majority of respondents had medium level of annual income. Similar findings were observed by Jadhav, [3] and Nigade, [4].

Table 1 revealed that majority (71.67 %) of respondents had medium area under soybean cultivation, followed by 19.17 and 9.16 per cent of respondents who had low and high area under soybean cultivation. It is clear that majority of the respondents had medium (i.e. between 0.92 to 2.71 ha.) area under soybean cultivation. This finding was consistent with findings of Sandip, [5]. It is clear from Table 1 that most of the respondents (55.83 %) were having medium level of social participation followed by low level of social participation (41.67 %), while 2.50 per cent of respondents were having high level of social participation. Table 1, makes it clear that most of the respondents were having medium level of social participation. Similar findings were also reported by Borse, [6] and Patel, [7].

Table 1. Distribution of soybean growers according to their profile

Sr. No.	Profile	Category	Frequency	Percentage
1	Education	Illiterate	01	00.83
		Can read only	05	04.17
		Can read and write	17	14.17
		Primary school level	22	18.33
		Middle school level	35	29.17
		High school	32	26.67
		Graduate	08	06.67
2	Land holding	Marginal (up to 1 ha.)	23	19.17
		Small (1 to 2 ha.)	49	40.83
		Semi medium (2.01 to 4.00 ha.)	37	30.83
		Medium (4.01 to 10.00 ha.)	05	04.17
		Large (10.01 ha. and above)	06	05.00
3	Annual income	Low (up to Rs.68874/-)	02	01.66
		Medium (Rs.68875 to Rs.321541/-)	107	89.17
		High (Rs.321542 and above)	11	09.17
4	Area under soybean cultivation	Low(up to 0.91)	23	19.17
		Medium (0.92 to 2.71)	86	71.67
		High (2.72 and above)	11	09.16
5	Extension contact	Low (up to 28.19)	23	19.17
		Medium (28.20 to 33.42)	84	70.00
		High (33.43 and above)	13	10.83
6	Social participation	Low (up to 1.07)	50	41.67
		Medium (1.08 to 2.14)	67	55.83
		High (2.15 and above)	03	02.50
7	Economic motivation	Low (up to 18.16)	24	20.00
		Medium (18.17 to 23.65)	84	70.00
		High (23.66 and above)	12	10.00
8	Risk orientation	Low (up to 17.77)	34	28.33
		Medium (17.78 to 22.56)	77	64.17
		High (22.57 and above)	09	07.50
9	Source of information	Low (up to 16.14)	06	05.00
		Medium (16.15 to 26.53)	89	74.17
		High (26.54 and above)	25	20.83
10	Innovativeness	Low (up to 6.56)	24	20.00
		Medium (6.57 to 10.35)	87	72.50
		High (10.36 and above)	09	07.50

Table 1 clearly indicated that 70.00 per cent of the respondents had medium extension contact, whereas 19.17 and 10.83 per cent of the respondents had low and high extension contact, respectively. It can be noticed that majority of the respondents had medium extension contact, followed by low and high extension contact. Similar findings were observed by Borse, [6] and Patel, [7]. Table 1 revealed that significant percentage (70.00 %) of the respondents were having medium economic motivation, followed by low level of economic motivation (20.00 %), while 10.00 per cent of respondents were having high economic motivation. This shows that most of respondents had medium economic motivation. This result was similar with results of Jadhav [3] and Nigade [4].

It is noticed from the Table 1 that majority of respondents (64.17 %) had medium risk orientation followed by low (28.33 %) and high (7.50 %) risk orientation. This shows that majority of respondents had medium risk orientation. This finding were in line with Rempuii [2] and Agale, [8]. Table 1 revealed majority of the respondents (74.17 %) were using medium source of information, followed by 20.83 and 5.00 per cent of respondents utilizing high and low sources of

information, respectively. It is clear from Table 1, that majority of the respondents had medium level source of information. Similar findings were seen by Nigade [4]. Table 1 indicated that majority of the respondents (72.50 %) belonged to medium innovativeness category, followed by low innovativeness category (20.00 %) and high innovativeness category (7.50 %). It was observed that majority of the respondents had medium level of innovativeness. This finding were in line with Bihare [9] and Nigade [4].

3.2 Relationship between Profile of the Respondents with their Knowledge

The relationship between profile of the respondents with their knowledge about the liquid biofertilizers are presented in Table 2.

Table 2 reported the relationships between profile factors of soybean growers and their knowledge of liquid biofertilizer technology. Education showed a highly significant positive relationship (r = 0.412**), indicating that better-educated farmers tend to have greater knowledge about liquid biofertilizers. Innovativeness (r = 0.335**) and sources of information (r = 0.321**) also showed a strong positive correlation, suggesting that growers who are more open to new ideas and those with access to diverse information sources are better informed about liquid biofertilizers. These findings are consistent with past research by Rajput, [10] and Shabbir [11] emphasizing the importance of education, access to information, and innovative mindsets in enhancing knowledge of agricultural technologies.

Profile of the respondents viz., area under soybean cultivation (r = 0.198*), extension contact (r = 0.194*), social participation (r = 0.183*), economic motivation (r = 0.216*), and risk orientation (r = 0.185*) showed a significant positive relationship with knowledge. These results suggest that farmers who cultivate larger areas of soybean, have greater contact with agricultural extension services, participate in social networks, and exhibit higher economic motivation and risk-taking tendencies are more likely to have a better understanding of liquid biofertilizers. This underscores the role of extension services, social interactions, and personal traits like risk orientation in enhancing knowledge dissemination among farmers.

Table 2. Relationship between profile of soybean growers and their knowledge

Sr. No.	Independent variables	Coefficient of Correlation (r)
1	Education	0.412**
2	Land holding	0.035^{NS}
3	Annual income	0.032^{NS}
4	Area under soybean cultivation	0.198*
5	Extension contact	0.194*
6	Social participation	0.183*
7	Economic motivation	0.216*
8	Risk orientation	0.185*
9	Source of information	0.321**
10	Innovativeness	0.335**

*NS=Non-significant, **=Significant at 0.01 per cent level, *=Significant at 0.05 per cent level*

Table 3. Relationship between profile of soybean growers and their adoption

Sr. No.	Independent variables	Coefficient of Correlation (r)
1	Education	0.287**
2	Land holding	0.115^{NS}
3	Annual income	0.118^{NS}
4	Area under soybean cultivation	0.232*
5	Extension contact	0.206*
6	Social participation	0.210*
7	Economic motivation	0.231*
8	Risk orientation	0.233*
9	Source of information	0.251**
10	Innovativeness	0.243**

*NS=Non-significant, **=Significant at 0.01 per cent level, *=Significant at 0.05 per cent level*

The data showed that landholding (r = 0.035NS) and annual income (r = 0.032NS) did not show a significant relationship with knowledge, indicating that wealth or farm size does not necessarily influence a farmer's understanding of liquid biofertilizer technology. This finding aligns with studies by Sundresha [12].

The data regarding relationship between profile of the respondents with their adoption of liquid biofertilizers technology are presented in Table 3.

The research findings from Table 3 indicate relationships between the profile characteristics of soybean growers and their adoption of liquid biofertilizer technology. It is reported that Education shows a highly significant positive relationship with adoption (r = 0.287**), suggesting that better-educated farmers are more likely to adopt liquid biofertilizers. Similarly, sources of information (r = 0.251**) and innovativeness (r = 0.243**) are significantly associated with adoption, highlighting the importance of access to diverse information and an openness to new technologies. These findings align with past studies by Rajput [10] and Maddina [13] emphasizing that education and innovativeness play crucial roles in the adoption of sustainable agricultural practices.

Profile of the respondents viz., area under soybean cultivation (r = 0.232*), extension contact (r = 0.206*), social participation (r = 0.210*), economic motivation (r = 0.231*), and risk orientation (r = 0.233*) show positive and significant relationships with adoption. This suggests that farmers with larger soybean areas, greater access to extension services, higher economic motivation, and a willingness to take risks are more likely to adopt liquid biofertilizers. These findings are in line with studies by Jaiswal [14] and Chahande [15] confirming that both personal traits and external support systems influence the adoption of new technologies. Whereas, landholding (r = 0.115NS) and annual income (r = 0.118NS) did not show a significant relationship with adoption. This indicates that a farmer's economic standing or farm size does not necessarily affect the adoption of liquid biofertilizer technology. These results are consistent with previous research by Verma [16] and Sundresha [12].

4. CONCLUSION

The profile analysis of soybean growers revealed that the most of respondents had medium levels of education, with having completed middle school and high school education. Most farmers were small landholders, cultivating soybean in medium-sized areas, with medium level of annual income, extension contact, social participation, economic motivation, risk orientation, sources of information, and innovativeness. The research finding reported that Education, Innovativeness and Source of information showed a highly significant positive relationship with the knowledge. Whereas, variables viz., area under soybean cultivation, extension contact, social participation, economic motivation, and risk orientation showed a significant positive relationship with knowledge. The data showed that landholding and annual income did not show a significant relationship with knowledge. Similarly, the adoption of liquid biofertilizer technology among soybean growers was significantly influenced by education, innovativeness, and source of information. Economic motivation and risk orientation also contributed positively to adoption rates. However, landholding and annual income showed no significant relationship with adoption, suggesting that wealth and farm size alone are not decisive factors in technology adoption.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Authors hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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