



KNOWLEDGE, ADOPTION, MARKETING, INTEGRATED PEST MANAGEMENT AND ITS CONSTRAINTS OF LEGUMES GROWER IN INDIAN SCENARIO: A REVIEW

Manoj Kumar¹, M.P. Gautam², R. K. Doharey³ and Shesh Narain Singh⁴, Ram Singh Yadav⁵ and Annu⁶

¹Department of Extension Education, CSAUAT, Kanpur, UP

²Department of Entomology, SVPUAT, Meerut, UP

³Department of Extension Education, ANDUAT, Narenda Nagar, Ayodhya, UP

⁴Krishi Vigyan Kendra, Sohna, Siddharthnagar, ANDUAT, Narenda Nagar, Ayodhya, UP

⁵Department of Agricultural Economics, ANDUAT, Narenda Nagar, Ayodhya, UP

⁶Department of Agricultural Statistics, ANDUAT, Narenda Nagar, Ayodhya, UP

Abstract

The present study was undertaken to find out adoption of package practices, marketing, constraints, Socio economic status, integrated pest management and recommended of legumes production technology. It was found that the independent variables, education, family size, social participation, size of land holding, age, extension contact, farming situation, education, social participation and risk orientation exposure had positive and significant association with the adoption level of the respondents regarding chickpea production technology. Majority of the farmers (small, marginal and medium) had fallen in medium category adoption about recommended cultivation practices of leguminous crops. Maximum number of legume growers were experienced various constraints in adoption of IPM practices, most of the respondents' highlighted non-availability of bio-agents, non availability of inputs at proper time (herbicide, traps and bio-pesticides etc.).

Keywords: Knowledge, Adoption, Marketing, IPM, Constraints, Legumes Grower and Indian.

Introduction

India is the largest producer, importer and consumer of pulses in the world, accounting for 25% of global production, 15% trade and 27% consumption. Pulses are chief source of protein and integral part of vegetarian human diet. The per capita availability of pulses in India is @ 42 g per day against the recommended dose of pulses for adult male and female 60 g and 55 g per day respectively (Tiwari and Shivhare, 2016). A variety of pulses are being grown in India including Chickpea (40%), Pigeonpea (18%), Blackgram (11%), Greengram (9%), Lentil (8%), Field pea (5%) and others (9%) are grown on 22-24 million ha. of area, producing 13-15 Mt. of grain with an average productivity of 6-6.5 tons/ha (Kumar and Kumawat, 2019). Uttar Pradesh state has a total area of 577 thousand ha, production of 475.4 thousand tones and yield 824 kg/ha under chickpea cultivation (Anonymous, 2017).

Socio-economic features of the legume grower farmers

Socio economic status

Patodia (2002) concluded that 56.67% of the total respondents belonged to middle class status, 22.92% had

lower class status and 20.41% respondents were in higher class status. Kumar *et al.* (2017) revealed that all the sampled farmers of Hamirpur district were using improved seed of pulses whereas fertilize was applied by all the sampled farmers of Chitrakut district. The plant protection measures used by all the selected farmers of Chitrakut, Jalaun and Mahoba districts. In Madhya Pradesh, about 90% selected farmers of Sagar and Tikamgarh district were using improved seed of pulses, application of DAP and pest management done by all the farmers.

Age

Patodia (2002) reveals that 66.67% of total respondent were in the middle age group of 31 to 50 years, 22.50% farmers were above 50 years, while 10.83% respondents were in 22 to 30 years age group. Jadav (2005) concluded that more than two third (76%) of the respondents were in middle and old age group.

Farming situation

Jadav (2005) concluded that the majority of the mango growers possessed medium to large size of farm holding and might have medium irrigation potentiality proportionate to their farm.

Education

Hanuman Lal (1990) concluded that of majority of respondents visited RAF were literate and they could read and write, only 23% of tribal and 23.5% of non-tribal belonged to the illiterate class who could neither read nor write, whereas 26% and 30% of tribal and non-tribal farmers, respectively had formal schooling (educated group).

Size of land holding

Patodia (2002) reveals that 42.92% farmers had small size of land holding, 32.91% were big farmers and 24.17% were marginal farmers. Jadav (2005) concluded that more number of the mango orchard growers had medium size of holding.

Education

Gerald and Shively (2001) A lot of literature categorizes education into formal, non-formal and informal education, each of which plays a different role in the farmer's process of decision making. All three types of education are important in the diffusion of innovations.

Social participation

Dangar (1996) revealed that majority (62%) of the chiku growers belonged to medium social participation. Chothani (1999) reported that majority (75) of the mango orchard growers had low social participation followed by medium (22%) and high (3%) social participation. Jadav (2005) summarized that majority of the mango orchard growers had medium social participation.

Annual income

Kanani (1998) indicated that about one third of the respondents had low income. About three-fifth of the respondents were from middle annual income while, negligible respondents (5%) were from higher income group. Chothani (1999) revealed that more than one half (83 percent) of the mango orchard growers fell under higher annual income group, while 24% and 13% fell under medium and lower annual income group, respectively.

Training received

Chothani (1999) concluded that a great majority (91%) of the mango orchard growers need medium training in relation to mango crop production. Jadav (2005) reported that 47% orchard growers were less trained followed by 29.50% of mango growers who untrained. The slightly less than one fourth (23.50%) of the mango orchards growers had more training regarding the management of mango orchard.

Credit behaviour

Jadav (2005) revealed that the mango orchard growers had to borrow credits for managing critical financial crisis from their relative, friends and cooperative bank.

Risk orientation

Kanani (1998) indicated that more than fifty percent (52.33%) respondents were from medium risk orientation group. Jadav (2005) indicated that more than two third (69.50%) for the respondents were from medium risk orientation group, whereas, 16.00 and 14.50 percent of them had low and high level of risk orientation, respectively.

Achievement motivation

Vyas (1995) concluded that majority (86%) of the respondents were found to have medium to high achievement motivation. Jadav (2005) revealed that nearby 68% respondent had medium level of achievement motivation followed by high (17.50%) and low level (14.50%) of achievement motivation.

Extension participation

Hanuman Lal (1990) concluded that the majority of farmers of both categories had medium extension participation. However, 29% tribal and 16.50% non-tribal farmers had high extension participation whereas, 24% of tribal and 10% of non-tribal farmers had low extension participation. Chothani (1999) revealed that majority (72) of the mango growers had medium extension participation followed by low (15%) and high (13%) participation in various extension activities. Jadav (2005) revealed that 72.50% of the mango growers had medium extension participation, whereas, 20% and 7.50% of them had low and high extension participation, respectively.

Knowledge level of legume grower farmer

Khan and Chauhan (2005) observed that adoption of new practices of groundnut cultivation indicated that all the respondents were following correct method of sowing and a good number of farmers *i.e.* 57.35% were using the recommended plant to plant and row to row distance. A fairly good number of farmers *i.e.* 54.70% were using fumigants in storage. The 38.72 and 38.66 percent followed recommended seed rate and seed treatment with seed dresser, respectively. Singh and Sharma, (2005) observed that beneficiary and non-beneficiary respondents possessed maximum knowledge regarding time of sowing and high yielding varieties of mustard crop. Similarly, they possessed poor knowledge regarding the physiological and weed management aspects of mustard cultivation. Geengar (2006) reported that majority of 73.33, 11.67 and 15 percent of tribal farmers and 71.67, 16.67 and 11.66 percent of non-tribal farmers were having medium, high and low knowledge level about maize production technology, respectively. Jaitawat (2006) concluded that cultivators possessed practice wise good knowledge regarding time of sowing, field preparation and seed rate, whereas, they possessed poor knowledge about improved varieties seeds and recommended schedule for plant protection measures. Nagar (2006) observed that majority of

the respondents (67.78%) had medium level of knowledge, whereas (14.45%) of the respondents had high level of knowledge and only (17.77%) of the respondents had low level of knowledge about recommended coriander cultivation technology.

Extent of adoption

Asiwal (2006) observed significant difference between the beneficiary and non-beneficiary respondent in extent of adoption of improved mustard production technology. It also showed direct and positive impact of FLD on beneficiary. Geengar (2006) found that majority of 63.34, 13.33 and 23.33 percent of tribal farmers and 68.33, 16.67 and 15.00 percent of non-tribal farmers were having medium, high and low adoption of maize production technology, respectively. Nagar (2006) reported that in general (61.12%) coriander growers were in the medium adoption group and (28.88%) respondents were in the low adoption group. While, only (10.00 %) farmers were in the high adoption. Agarwal (2008) found that the majority (70%) of the respondents were good adopters of recommended gram production technologies. Only 17.50% respondents fell in the category of poor adopters.

Association between knowledge levels and education of legume grower farmer

Geengar (2006) concluded that the tribal farmers were found to have non-significant association with education and knowledge level of maize production technology. Whereas, the non-tribal farmers were found to have significant association with education and knowledge level of maize production technology. Jaitawat (2006) concluded that the education, family structure, size of land holding, social participation, farm assets, training received, extension participation, economic motivation, progressiveness and overall adoption were positively and significantly related with the knowledge level of the farmers about recommended cumin cultivation technology.

Constraints on marketing of legume grower

Agarwal (2008) found that the farmers of the study area were facing constraints under the head of marketing constraints (1.94 mean score) and plant protection measures (1.79 mean score) followed by harvesting and storage (1.73 mean score) and chemical weedicide (1.68 mean score) whereas the farmers faced less problems under the heads sowing method (1.35 mean score) and critical irrigation (1.41 mean score) respectively in adoption of gram production technology. Bankar (2008) found constraints in pulse production were - (i) unfavorable climatic conditions either with heavy rains or long dry spells (ii) late onset of monsoon delays sowing of *kharif* pulses affects yield adversely (iii) many of traditional varieties are late maturity and they get susceptible to major diseases like wilt, sterility mosaic root rot

(iv) moisture stress during flowering and pod filling stage results in shading of flowers and immature pod (v) heavy and conditions rains during flowering and pod filling stages make it difficult to protect crop from pests (vi) if rains occurs at harvesting of mung bean and urd bean the grains sprouts in pod itself and thereby cause damage to quantity and yield of crops (vii) endemic soils also play an important role in producing fusarium wilt in gram crop (viii) if timely and an adequate proportion of plant protection measures are not taken up creates problems of pod borers and many other pest causing serious damage to all pulse crops (ix) if recommended seed rate were not used, it often lead to poor plant stand (x) fluctuations in market price.

Knowledge level of legume grower

“Knowledge is of two kinds, we known as a subject or we know where we can find information upon it” (Samuel Johnson). Singh *et al.* (2014) conducted a study in western arid zone of Rajasthan with selection of Bikaner and Churu districts on sample of 316 moth cultivating farmers. The study highlighted that the majority of farmers had medium level of knowledge regarding moth cultivation. Jakhar *et al.* (2014) conducted a study in Nagaur district of Rajasthan on 120 mungbean growers and found that among the marginal farmers 66.67% were having medium knowledge, whereas, 18.33% having low knowledge and remaining 15% possessed high knowledge, in case of small farmers, 78.33% were having medium knowledge, whereas, 10% having low knowledge and remaining 11.67% possessed high knowledge about recommended cultivation practices of mungbean . Patodiya *et al.* (2013) concluded that majority of the farmers were in medium knowledge group followed by high and low knowledge group, respectively in all the selected pulses crops. Badhala *et al.* (2014) found that there was a significant difference in existing knowledge of beneficiary and non-beneficiary farmers except to harvesting with respect to gram production technology. Singh *et al.* (2012) conducted a study in 19 villages of Bikaner and Churu districts of Rajasthan with the sample size of 316 moth growers and found that the knowledge level about recommended cultivation practices of moth was observed to the extent of medium level in case (69.30%) of moth growers. Quite a few (14.24%) of them were found to possess enough knowledge about recommended production technology of moth. Kumari *et al.* (2011) found that the poor extent of knowledge was reported for the practices *viz.*, manuring and fertilizer application, insect and pest control, seed treatment and disease which were ranked at 10th (65%), 11th (61.25%), 12th (47.5%) and 13th (47.08%), respectively. Singh *et al.* (2011) conducted a study in Rajasthan with sample size of 316 respondents and found that majority of respondents had medium level of knowledge about cluster production technology. Manjushree and Patil, (2019) revealed that nearly two fifth (39%) of the chickpea growers had medium level of knowledge about recommended

cultivation practices of chickpea. It was observed that per cent of chickpea growers possessed knowledge about recommended soil, land preparation, varieties, season of sowing, method of application of chemical fertilizer, inter cultivation, time of harvesting, symptoms of pest and disease and yield.

Concept of knowledge

The behavior and test situation, which emphasized remembering either by recognition or recall of material, phenomena or ideas. Another classic definition of knowledge is “the body of understood information possessed by a personality or by a culture”. He further explained knowledge as “that part of a person's in order which is in accordance with recognized fact”.

Extent of adoption level of legume grower

It is a judgment to make full use of new thoughts as the best route of action available. The term in this study has been used to mean the use of enhanced practice of gram in the field by the farmers. Meena, (2010) found that 11.88% farmers were high adopters, 37.50% farmers were low level adopters and 50.62% farmers were in the category of medium adopters of coriander production technology. Singh and Chauhan (2010) found that majority of the marginal, small and large farmers belonged to low adoption category for the mungbean production technologies such as 'high yielding varieties', 'seed treatment', 'application of organic manure', 'application of nitrogenous fertilizers', 'application of phosphatic fertilizers' and 'plant protection measures'. Medium level of adoption is found for the practices such as 'time of sowing' and 'inter culture and weeding' while high adoption is noticed for the practices such as 'seed rate', 'method of sowing' and 'spacing'. Thoke (2010) observed that the majority of chickpea growers (70.54%) had medium level of adoption. It can be stated that the level of adoption of the chickpea cultivation practices by majority of the chickpea growers was satisfactory. Chandawat *et al.* (2012) found that the most adopted practices were suitable soil type, application of FYM, land preparation, no. of irrigation & stages of irrigation, hand weeding and no. of hand weeding and harmful insect infestation. While least adopted practices were chemical weed control, disease control methods, seed treatment, seed treatment with bio-fertilizers, use of improved seeds, spacing between row and plants and use of recommended dose of nitrogenous fertilizers etc. Solanki *et al.* (2012) found that the two-thirds of the respondents (63.33%) had medium extent of adoption of recommended production technology of Kidney bean. Yadav and Khan, (2012) found that 67% of the farmers were found to be medium adopters, while 18% farmers were high adopters and only 15% of farmers were low adopters. Shashikant *et al.* (2014) observed that out of the selected 60 farmers around 90% were observed under the category of medium to high level of technology adopters. The technology adoption index

was highest on large farms followed by medium and small farms. Patel *et al.* (2019) adoption has increased by 15.65 and 24.82 percent after exposure to training and demonstration respectively to the farmers and both the methods were found to be significant at 0.01 level of significance for enhancing level of adoption among farmers. Therefore, potentialities of these methods could be best exploited by field extension functionaries and other stakeholders in enhancing level of adoption among farmers.

The concept of adoption of legume cultivation

Adoption is an innovation choice development through which an individual passes from first knowledge of innovation to a choice to adopt or refuse to later confirmation of this decision. There are four functions in this process *i.e.*, persuasion, knowledge, confirmation and decision. It appears from the various studies on adoption that adoption is both a process involving some stages of decision making and a stage in the process where the farmers begin the full use of an innovation.

Association between the extents of adoption of recommended cultivation

Jat, (2011) found that five selected independent variables *viz.*, educational level, social participation, size of land holding irrigation potentiality and sources of information utilized were found positively and significantly associated while two independent variables *viz.*, size of family and market distance was found to be non-significantly association with the adoption of recommended cultivation practices of barley. Singh (2011) conducted a study in four districts namely Jodhpur, Pali, Bikaner and Jaisalmer of Rajasthan on 144 mungbean growing farmers. The study revealed that out of sixteen variables, two variables *i.e.* occupation and knowledge were found to be positively and significantly correlated with adoption of mungbean production technology. Mane *et al.* (2012) found that out of five variable *viz.*, education, land holding, annual income, source of information and knowledge had positive and significant relationship with adoption level at 0.01 level of probability while single variable *i.e.* economic motivation had positive and significant relationship with adoption level at 0.05 level of probability. Singh *et al.* (2012) conducted a study in western arid zone of Rajasthan in Bikaner and Churu districts on 316 farmers and found that the out of 14 independent variables, 12 independent variables were found to have highly significant association with level of knowledge and extent of adoption by moth growers. Tamil and Hazarika, (2012) revealed that extension contact, mass media exposure, knowledge and attitude towards dairy farming of the tribal dairy farmers were found to have significant and positive correlation with extent of adoption. The rest variables like, respondent's education, age, experience in dairy farming,

social contribution, family education status, annual family income, land size, livestock's enterprise, economic motivation had positive but non-significant correlation with the extent of adoption but the variable like family size, herd size, value orientation and aspiration level had negative and non significant correlation with extent of adoption of scientific dairy management.

Constraints in adoption of legume grower

Constraints refer to the forcible limitations in confinement of action. In this study constraints are operationalized as impediment or obstacles in the successful adoption of recommended cultivation practices of gram. The simplest dictionary meaning of constraint is to force, to compel, to restrain, to contract, to violate, to straighten to confine, to distress, to limit, affection, to press, restriction of liberty, restricted to avoid or perform same action. Kumar, (2009 & 2010) conducted study in Jammu district on 80 pulse growing farmers and found that the main constraints faced by pulse grower were non availability of improved variety seeds, manure and fertilizers in time, lack of knowledge regarding weed control and lack of regulated market for sale. Jat *et al.* (2011) found that there are various constraints like weed control through herbicide, absence of assured marketing facility, weedicides and plant protection measures, lack of operational skill in the plant protection equipments and sandy storm, lack of knowledge about improved technologies of seed, high wind velocity and high temperature affect the growth of crop and productivity were faced by the farmers in adoption of recommended production technology of mothbean. Chandawat *et al.* (2012) conducted a study in the Kheda district of Gujrat and find out that many constraints faced by the gram growers, lack of timely availability of agricultural labour lack of market facility, lack of timely & adequate availability of irrigation water, most important constraints were lack of timely availability of certified seed at locally, higher cost of agricultural inputs etc. lower price of agricultural produce, lack of facility for farm produce storage and shortage of chemical fertilizers during the season was expressed by moderate no. of respondents as constraints. Timely unavailability of farm implements and soil affected by salinity were least constraints faced by the respondents. Lack of knowledge about timely information and technical guidance (78.75%) and lack of knowledge about appropriate time of spraying of pesticides (70%). The findings were in accordance with respect of (Dwivedi *et al.*, 2010; Singh *et al.*, 2012 and Singh *et al.*, 2014).

Concept of constraints

Constraints extent for "The state or qualities of sense being restricted to a given course of action or constraints are nothing but the problems that come in the way of adoption of technology".

Insect pest and disease management of legume crops

In case of insect pest and disease management about control measure for Cutworm from Lindane 6%, majority 68.981% of respondents were non- adopters followed by partial adopters 25.462% and last was full adopters 5.557% (Singh *et al.*, 2019). It was found that about control measure for Gram pod borer from Monocrotophos 36 EC, majority 70.370% of respondents were non- adopter followed by partial adopters 22.222% and last was full adopters 7.408%. Majority 67.129% of respondents were non-adopters control measure for Wilt from Benlate Thiram (1:1) followed by partial adopters 28.242% and last was full adopters 4.629% (Rajbhar *et al.*, 2018). Tiwari *et al.* (2020) found that 65% respondents belonged to low adoption level of integrated plant protection practices followed by medium (35%) and high level (10%). Practice wise adoption level was reported that, 81.25% respondents were adopted timely sowing followed by mixed and intercropping with linseed/mustard (68.75%), crop rotation (43.75%), deep summer ploughing and destruction of stubbles (15%), selection of disease and insect resistant varieties (5%) and line sowing (3.75%) while application of neem cake/ground nut cake were not adopted by the respondents. 17.50% respondents were adopted weed management practices while 8.75% respondents were accepted hand removal of pest and disease affected plants/plant parts. Only 10% of the respondents had high level of adoption towards the recommended components of IPM technology while 35% respondents were found to be medium adoption of IPM practices. Similar findings were reported by Singh *et al.*, 2013 and 2014.

Constraints faced by legume growers in adoption of IPM practices

Kerketta (2015) revealed that the majority (91.66%) of the respondents reported, non availability of bio-agents (NPV, parasites etc.), followed by Non-availability of inputs at a time (bio-pesticides, traps, herbicides etc.) (90%), lack of proper training conduct for IPM practices by extension agent or agencies (80.83%) are considered as major constraints.

Conclusion

Nearly half of the respondents were in medium level of adoption of scientific package of practices of chickpea, thus, a series of awareness programmes, field visits, field days, other interaction meetings should be organized for better reach of scientific Package of practices o chickpea. Extension methods like training and demonstration were found impactful in terms enhancing level of adoption of scientific package of practices of chickpea. Thus these extension methods need to be popularized and used efficiently by extension organizations to obtain maximum productivity. Today many of the crop production level gone down therefore need to adopt the IPM

strategies by using appropriate combination of cultural, mechanical, biological and chemical control methods.

Acknowledgement

The authors are thankful to HOD and entire faculty, Department of Extension Education, ANDUA&T, Ayodhya for providing guidance and support to conduct this study. They also thank the anonymous referee for suggesting improvement in presentation of the paper. They are also thankful to the farmers for sparing time to give interviews.

References

- Agarwal JK (2008). Impact of Major Crop Production Technologies Generated by Rajasthan Agricultural University for the Semi-arid Eastern Plain of Rajasthan. Ph.D. Thesis (Unpublished), Rajasthan Agricultural University, Bikaner, Campus-Jobner.
- Anonymous (2017). Annual Report. government of India Ministry of agriculture & Farmers Welfare (Department of Agriculture, Cooperation & Farmers Welfare) Directorate of Pulses Development Vindhyachal Bhavan, 2016-17.
- Asiwal BL (2006). Impact of front line demonstration on adoption of improved mustard production technology among the farmers of laxmangarh panchayat samiti of sikar district of Rajasthan. M.Sc. (Ag.) Thesis (unpublished), Rajasthan agricultural university, Bikaner, campus-Jobner.
- Bankar KB (2008). Constraints and strategies in pulses Production. *Agrobios newsletters*, 7(7): 25.
- Chandawat MS, Sharma PK and Parmar AB (2012). Extent of Adoption about Improved Cultivation Practices of Gram Crop and Constraints Faced by the Farmers of Kheda District. *Guj.J. Extn. Edu.*, 23.
- Chothani SB (1999). Training needs of mango orchard growers of Junagadh district. Unpublished M.Sc. (Ag.) Thesis, G.A.U, S.K. Nagar.
- Chothani SB (1999). Training needs of mango orchard growers of Junagadh district. Unpublished M.Sc. (Ag.) Thesis, G.A.U, S.K. Nagar.
- Dangar MM (1996). A study of knowledge, adoption and constrains of chiku growers" in Junagadh district of Gujarat state. Unpublished M.Sc. (Ag.) Thesis, G.A.U, S.K. Nagar.
- Dwivedi AP, Singh BP, Singh RP and Singh M (2010). Extent of adoption of recommended production technology of pigeon pea by farmers. Extension Strategies for Agriculture and Rural Development. Daya Publishing House, New Delhi, 321-326.
- Geenger HK (2006). Knowledge and adoption of maize production technology by the tribal and non-tribal farmers in Jahazpur panchayat samiti of Bhilwara district (Raj.). M.Sc. (Ag.) Thesis Rajasthan Agricultural University, Campus-Jobner.
- Gerald E and Shively (2001) Poverty, Consumption Risk, and Soil Conservation, *Journal of Development Economics*, 65(2): 267-290.
- Hanuman Lal (1990). Impact of rural agricultural fair on learning behaviour of tribal and non-tribal farmers of Rajasthan. Unpublished Ph.D. Thesis, Rajasthan Agricultural University, Bikaner, Campus-Udaipur.
- Jadav NB (2005). Managerial ability of mango growers about scientific cultivation of mango orchards. Unpublished Ph.D. Thesis, GAU, Junagarh.
- Jakhar PR, Bangarva GS and Jat JR (2014). Knowledge level of farmers about recommended cultivation practices of mungbean in nagaur district of rajasthan. *Ind. J. Extn. Edu. & R.D.*, 22: 172-176.
- Jat HL, Singh P and Lakhera JP (2011). Constraints in adoption of moth bean production technology in arid zone of Rajasthan. *Raj. J. Extn.Edu.*, 19: 185-189.
- Kanani PR (1998). Indigenous practices of groundnut cultivation followed by the farmers of South Saurashtra Zone of Gujarat State. Unpublished Ph.D. (Ag.) Thesis, G.A.U, S.K. Nagar.
- Kanani PR (1998). Indigenous practices of groundnut cultivation followed by the farmers of South Saurashtra Zone of Gujarat State. Unpublished Ph.D. (Ag.) Thesis, G.A.U, S.K. Nagar.
- Kumar R, Singh SK and Sah U (2017). Multidimensional study of pulse production in Bundelkhand region of India. *Legume Research*, 40(6): 1046-1052.
- Kumar M and Kumawat SR (2019). Knowledge level of farmers about chickpea production technology in Nagaur District of Rajasthan. *Journal of Krishi Vigyan*, 8(1): 187-190.
- Kumari M, Kumar D and Kumar A (2011). Knowledge extent of farmers about Bengal gram production technology. *Environment and Ecology*, 29(4A): 2120-2123.
- Mane SS, Kolgane BT and Khogare DT (2012). Study on knowledge and adoption of *Kharif* green gram cultivation practices. *Agriculture Update*, 7(1/2): 23-26.
- Manjushree S and Patil SL (2019). Knowledge of chickpea growers about recommended cultivation practices. *J. Farm Sci.*, 32(3): 322-329.
- Meena DK (2010). Knowledge and adoption of coriander (*Coriandrum sativum* L.) production technology by the tribal and non-tribal farmers in Jhalawar district of Rajasthan. M.Sc. (Ag.) Thesis, S.K.R.A.U., Bikaner.
- Nagar SN (2006). Knowledge and adoption of recommended coriander cultivation technology among the farmers of

- Atru tehsil in Baran district of Rajasthan. M.Sc. (Ag.) Thesis, MPUAT, Udaipur Campus, Udaipur.
- Nikam PS, Jagtap GP and Sontakke PL (2007). Management of chickpea wilt caused by *Fusarium oxysporum f. sp. ciceri*. *African Journal of Agricultural Research*, **2**: 692-697.
- Patel D, Singh S, Verma AP, Gupta BK and Singh M (2019). Impact of different extension teaching methods for adoption of scientific package of practices of chickpea, *Indian Journal of Extension Education*, **55**(2): 91-93.
- Patodia RS (2002). A critical study on adoption of improved technologies of important crops by the farmers in agro climatic zone III A of Rajasthan: Ph.D. Thesis, Rajasthan Agricultural University, Bikaner Campus, Jobner.
- Patodia RS (2002). A critical study on adoption of improved technologies of important crops by the farmers in agro climatic zone III A of Rajasthan: Ph.D. Thesis, Rajasthan Agricultural University, Bikaner Campus, Jobner.
- Patodiya RS, Meena BL and Rajeev Bairathi (2013). Knowledge of improved production technologies of pulses by the farmers in Rajsamand district. *Ind. J. Extn. Educ. & R.D.*, **21**: 173-176.
- Rajbhar AK, Singh HC, Jha KK, Kumar M and Maurya K (2018). Adoption of chickpea production technology among farmers in central plain zone of Uttar Pradesh. *Journal of Pharmacognosy and Phytochemistry*, **7**(4): 2250-2254.
- Shashikant VG, Dubey LR and Patil GGI (2014). Technological gaps in red gram production in Gulbarga district of Karnataka. *Agril. Science Digest*, **34**(1): 45-48.
- Singh AP, Doharey RK, Singh P, Kumar M, Singh RK and Pandey RK (2019). Adoption level of farmers about recommended cultivation practices of green gram (summer season) in Fatehpur district of Uttar Pradesh. *Journal of Pharmacognosy and Phytochemistry*, **8**(1): 411-413.
- Singh B (2011). Factors influencing the adoption of mungbean production technology in arid zone of Rajasthan. *Raj. J. Extn. Edu.*, **19**: 173-177.
- Singh B and Chauhan TR (2010). Adoption of mungbean production technology in arid zone of Rajasthan. *Ind. Res. J. Extn. Edu.*, **10**(2): 73-77.
- Singh N and Sharma FL (2005). Impact of front line demonstration on gain in knowledge about mustard production technology among farmers. *Indian Research Journal of Extension Education*, **5**(1): 41-43.
- Singh P, Jat HL and Lakhera JP (2012). Constraints in Adoption of Moth Production Technology in Arid Zone of Rajasthan. *Ind. Res. J. Extn. Edu*, Special Issue-II.
- Singh P, Lakhera JP and Chandra S (2014). Knowledge and adoption of moth production technology in western zone of Rajasthan. *Raj. J. Extn. Edu.*, **20**: 35-38.
- Singh RP, Singh AN, Dwivedi AP, Mishra A and Singh M (2012). Assessment of yield in chickpea through frontier technology. *Journal of Extension Education*, **17**: 85-89.
- Singh RP, Singh D, Dwivedi AP and Singh M (2014). Adoption level of integrated pest management technology in chickpea. *Journal of Food Legumes*, **27**(2): 170-173.
- Singh RP, Singh D, Dwivedi AP and Singh M (2013). IPM Technology in chickpea: Adoption pattern and constraints. Published in Souvenir cum Compendium First UP Agricultural Science Congress, 17-19.
- Singh R, Bishnoi DK and Godara AS (2009). Economics of rainfed gram (*Cicer arietinum* L.) in Rajasthan. *Legume Research*, **33**: 58-60.
- Solanki J, Solanki KD and Prajapati M (2012). Extent of Adoption of Recommended Kidney Production Technology. *Guj. J. Extn. Edu*, **23**.
- Tamil UR and Hazarika (2012). Association between in the personal, socioeconomic, communication and psychological variables and the extent of adoption of scientific dairy management practices of tribal dairy farmers. *Ind. J. Social Res.*, **53**(3): 187-190.
- Thoke NJ and Surya G (2010). Adoption behaviour of farmers in chickpea production technology. *Agriculture Update*, **5**(3/4): 352-355.
- Tiwari AK and Shivhare AK (2016). Pulses in India: Retrospect and Prospects, Directorate of Pulses Development, Department of Agriculture, Cooperation and Farmers Welfare, Government of Madhya Pradesh.
- Tiwari AK, Singh KK, Dwivedi AP and Singh RP (2020). Adoption level and constraints of IPM technology in chickpea growers of Raebareli district of Uttar Pradesh. *Journal of Entomology and Zoology Studies*, **8**(5): 750-755.
- Vyas HU (1995). Management efficiency and economic performance of milk producers in Panch Mahal District of Gujarat State. Ph.D. Thesis (Unpublished), G.A.U., S.K. Nagar.
- Yadav BS and Khan IM (2012). Adoption of improved cultivation practices of cauliflower. *Ind. J. Social Res.*, **53**(3): 191-197.