



What influences the intention of farmers to use green organic fertilizer? Introducing green awareness into the theory of planned behavior

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ABSTRACT: China is the biggest muskmelon producing country across the world. Extreme application of fertilizer during planting of muskmelon poses a serious threat to the environment and food safety, so how to promote farmers to use organic fertilizer has become an important topic. This study creatively introduced green awareness into the extended framework of theory of planned behavior to explore the decisive factors of muskmelon farmers' behavior intention to apply green organic fertilizer. The structural equation model is used for investigating behavior intention of 543 muskmelon farmers in Leting County, China. The results suggested that both subjective norm and green awareness can affect muskmelon farmers' behavior intention positively and significantly. When the subjective norm increases by 1 standard deviation, the farmers' intention increases by 1.028 standard deviation; for every 1 standard deviation increase in green awareness, the farmers' intention increased by 0.703 standard deviation.

Key words: green awareness, SEM, TPB, behavior intention.

O que influencia a intenção dos agricultores de usar fertilizante orgânico verde? Introduzindo a consciência verde na teoria do comportamento planejado

RESUMO: A China é o maior país produtor de melão em todo o mundo. A aplicação extrema de fertilizantes durante o plantio de melão representa uma séria ameaça ao meio ambiente e à segurança alimentar, portanto, como promover os agricultores a usar fertilizante orgânico verde tornou-se um tópico importante. Este estudo introduziu criativamente a consciência verde no quadro estendido da teoria do comportamento, planejado para explorar os fatores decisivos da intenção dos agricultores de melão de aplicar fertilizante orgânico verde. O modelo de equações estruturais é usado para investigar a intenção de comportamento de 543 agricultores de melão no Condado de Leting, China. Os resultados sugerem que tanto a norma subjetiva quanto a consciência verde podem afetar positiva e significativamente o comportamento dos produtores de melão. Quando a norma subjetiva aumenta em 1, o desvio padrão, a intenção do agricultor aumenta em 1,028 desvio padrão. Para cada aumento de 1 desvio padrão na consciência verde, a intenção dos agricultores aumentou em 0,703 desvio padrão.

Palavras-chave: sensibilização ecológica, SEM, TPB, intenção de comportamento.

INTRODUCTION

China is the biggest muskmelon producing country across the world. In 2021, China's muskmelon planting area will reach 386.6 thousand hectares, accounting for 3.02 percent of the country's orchard area, and muskmelon production will reach 13.771 million tons (RURAL SOCIAL AND ECONOMIC SURVEY DEPARTMENT OF THE NATIONAL BUREAU OF STATISTICS, 2022). China's muskmelon has strong competitiveness in the international market. In 2022, the total export volume of China's muskmelon will be about 62,900 tons (NETEASE, 2023). Because muskmelon can bring huge economic benefits to muskmelon farmers, in order to increase the yield of muskmelon, Chinese muskmelon farmers not only improve the planting technology of muskmelon, but also continuously

increase the use of chemical products such as chemical fertilizer (BIN et al., 2022). However, the overuse of chemical fertilizers can do great harm to the environment. Some chemical fertilizers contain harmful ingredients that cannot be decomposed in the soil. Long-term application will cause the accumulation of harmful substances in the soil, thus causing a train of troubles, for instance, soil compaction and serious contamination of crops and water resources (LI & WU, 2008). The effects of chemical fertilizer on soil degradation and compaction have been studied for a long time. Through randomized complete block design, the researchers reported that over-application of chemical fertilizer would lead to the formation of chemical fertilizer mineral salts and continuous accumulation in the soil. This accumulation eventually leads to compaction of the soil layer, which leads to soil degradation; soil

compaction has adverse effects on almost all physical, chemical and biological properties of soil (MASSAH & AZADEGAN, 2016). Other researchers have pointed out that nitrate pollution in groundwater and surface waters around the world is closely related to the continuous increase in fertilizer nitrogen use; strengthening fertilizer management can reduce nitrate pollution of fertilizer to water (CRASWELL, 2021). Therefore, it has a great meaning for studying the use of green organic fertilizer.

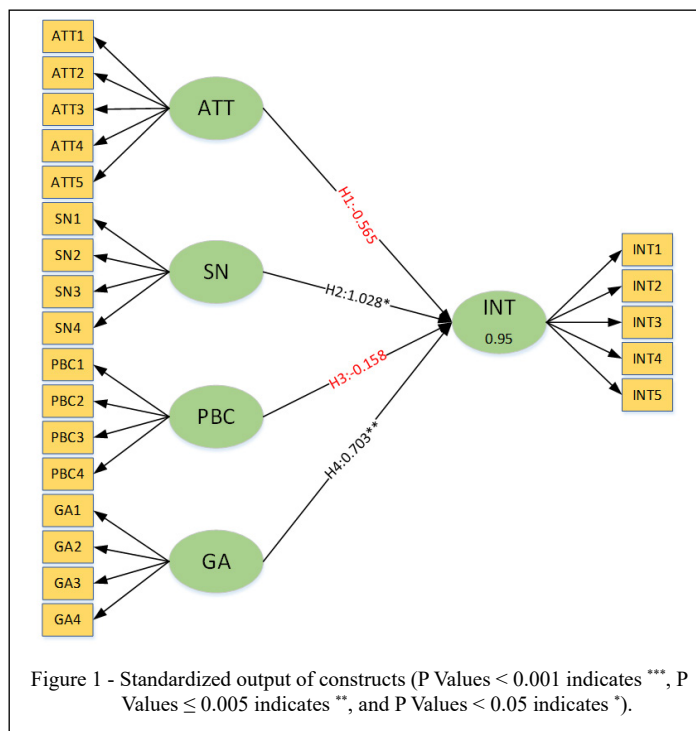
In the past, there have been a lot of studies on the application effect of green organic fertilizer (KHALIQ et al., 2004), the fertilization methods and technologies of green organic fertilizer (BRIUKHANOV et al., 2017), and the influencing factors of farmers' intention to apply green organic fertilizer (SAVARI & GHARECHAEI, 2020; ZHANG et al., 2021). However, the present research mostly focus on the technical level and ignore the research on the psychological factors influencing the mechanism led by green awareness (ADNAN et al., 2019). Green awareness refers to the consciousness that human beings give priority to green behavior in their behavioral activities in pursuit of harmonious coexistence between human and nature. The current studies on green awareness principally focus on: the impact of green awareness on consumers' purchase intention (AYODELE et al., 2017), the influencing

factors of green awareness (ALAMSYAH & MUHAMMED, 2022; ALAMSYAH et al., 2021) and the specific practical research on improving individual green awareness (TO et al., 2013; MAURER et al., 2020). Therefore, it is necessary to include green awareness as the core factor of farmers' behavior intention into TPB model.

The innovation of this paper lies in: (1) It is the first time to study the behavior intention of muskmelon farmers to apply green organic fertilizer from the psychological perspective, and add the green awareness into the TPB model to expand TPB model; (2) Break the previous pattern of studying the influence of green awareness on behavior from the perspective of consumers, and discuss the influence of green awareness on behavior intention of applying green organic fertilizer from the perspective of producers green awareness.

To make up for the shortcomings of previous studies, we added green cognition to TPB, constructed and extended TPB, and studied the factors affecting the intention of muskmelon farmers to apply green organic fertilizer. Based on previous studies, the following hypothesis was proposed (Figure 1).

Attitude mean a person opinion or position towards a specific object. Ajzen believes that people who have a positive attitude towards a certain behavior are more possible to take the behavior (AJZEN,



1991). Many studies have emphasized the important role of attitude in predicting the environmentally friendly behavior in various domains, like farmers' safe application of chemical fertilizer, consumers' low-carbon consumption behavior, e-waste recycling behavior, tourists' environmental protection behavior in the tourism process, and these studies have come to the conclusion that a positive attitude is helpful for human beings to take environmental protection behavior (SAVARI & GHARECHAE, 2020; ABOELMAGED, 2021). In conclusion, this research believed that muskmelon farmers with positive attitude towards the application of green organic fertilizer can maintain a positive evaluation of all aspects of green organic fertilizer in the process of planting Leling muskmelon. They are more willing to choose to apply green organic fertilizer, but also easier to accept some shortcomings of green organic fertilizer with an optimistic attitude and overcome the technical difficulties encountered in the application of green organic fertilizer; On the contrary, muskmelon farmers who have a negative attitude towards the application of green organic fertilizer will have a resistance to green organic fertilizer in the planting process, which makes them unwilling to choose to apply green organic fertilizer even if they know the unique advantages of green organic fertilizer compared with chemical fertilizer. H1. Attitude can affect farmer's behavior intention positively.

Subjective norm refers to how people perceive other people's evaluations of their behavior (SAVARI & GHARECHAE, 2020). Subjective norm is a social factor, which is the social pressure that individuals feel about whether to take a specific behavior; This pressure will have an effect on personal behavior intention. And the greater the pressure, the greater the impact (AITKEN et al., 2020). Many researches have shown the significance of subjective norm in predicting the environmentally friendly behavior of farmers in various domains like farmers' safe use of chemical fertilizer and individuals' energy saving behavior at home, and have come to the conclusion that subjective norm can affect behavior intention positively (SAVARI & GHARECHAE, 2020). This study believed that those muskmelon farmers who are more susceptible to the views and opinions of the surrounding people are more likely to change their original production habits and use green organic fertilizer under the suggestions and pressure of the surrounding people. For those muskmelon farmers who are not easily affected by the surrounding people, the planting process and suggestions of the surrounding muskmelon farmers are difficult to bring

pressure to them, so it is difficult for them to decide whether to apply green organic fertilizer according to the fertilization behavior taken by the surrounding melon farmers. H2. Subjective norm can affect farmer's behavior intention positively.

Perceived behavioral control means some specific factors, which will have a direct effect on people's behavior intention and even behavior (SAVARI & GHARECHAE, 2020). The higher the perceived behavioral control, the easier it is to take the behavior (AJZEN, 2002). At present, many researches have proved the significance of perceived behavioral control in predicting environmentally friendly behavior in various domains like farmers' safe use of chemical fertilizer, consumers' low-carbon consumption behavior, and food conservation behavior, and all have come to the conclusion that the effect of perceived behavioral control is positive (SAVARI & GHARECHAE, 2020). This study believed that a muskmelon farmer who is proficient in the production and application of green organic fertilizer and has enough time, energy and funds to study and apply green organic fertilizer is more likely to apply green organic fertilizer in the process of planting Leling muskmelon. However, if a muskmelon farmer does not have the necessary conditions to apply green organic fertilizer, like lack of knowledge about the production and application of green organic fertilizer, or do not have the time and money to apply green organic fertilizer, they will not be able to apply green organic fertilizer in the cultivation process of muskmelon. H3. Perceived behavioral control can affect farmer's behavior intention positively.

Green awareness refers to the consciousness that human beings give priority to green behavior in their behavioral activities in order to pursue the harmonious coexistence between human and nature. Previous studies have proved that the stronger the individual's green awareness, the greater the positive effect on green behavior intention (PAÇO & RAPOSO, 2010; WU & CHEN, 2014). For example, in previous studies on consumers' green awareness, many researchers pointed out that green awareness has a positive effect on whether consumers adopt green consumption behavior (PAÇO & RAPOSO, 2010; WU & CHEN, 2014); Furthermore, consumers' green awareness is influenced by the quality of green products, price of green products, environmental protection publicity and other aspects, so consumers' green awareness affects consumers' behavior intention in many aspects, and it is hard to change at short notice, which is the most important influencing factor of consumers' environmental protection behavior (PAÇO

& RAPOSO, 2010; WU & CHEN, 2014). This research believed that muskmelon farmers with strong green awareness have stronger awareness of environmental protection and green production; Therefore, in the process of planting Leting muskmelon, these muskmelon farmers will be more active in using green organic fertilizer and more determined to choose an environmentally friendly production mode in the face of the temptation of short-term profits brought by chemical fertilizer. H4. Green awareness can affect farmer's intention positively.

MATERIALS AND METHODS

Research methods

Structural equation model originated from the path analysis invented by Sewall Wright (TERANO et al., 2015). The model integrated the methods of factor analysis, correlation analysis and regression analysis. It can not only deal with significant variables and latent variables that cannot be observed directly, but also analyze and study the direct and indirect effects between variables, as well as the size and direction of effects. It is a extremely important multivariate data analysis tool (ZHANG et al., 2021).

Structural equation model is divided into structural model and measurement model. The specific expression of the structural model is: $\eta = B\eta + \Gamma\xi + \zeta$. The specific expression of the measurement model is: $x = \Lambda_x\xi + \delta$, $y = \Lambda_y\eta + \varepsilon$.

This study is quantitative in nature and practical in objective. The specific content of this paper is to study the influence of farmers' attitude, subjective norm, perceived behavior control and green awareness on their behavior intention. Since the influencing factors in this study are all latent variables, the structural equation model is used for the study.

Study area and sample selection

Study area

Leting County is one of the coastal counties in Hebei Province (Figure 2). According to the investigation of Tangshan Labor Daily in 2017, as of 2017, the Leting facility muskmelon planting area reached 110,000 mu, and the annual output of muskmelon had reached 495000 tons (SIDDIQUE & HOSSAIN, 2018).

Sample and data collection

This study used multi-stage hierarchical cluster sampling method. Firstly, based on the basic

direction, the study selects five towns: Maozhuang town (the middle of Leting county), Tingliuhe town (the north of Leting county), Matouying town (the south of Leting county), Xinzhai town (the west of Leting county) and Jianggezhuang town (the east of Leting county)(Note: there are few muskmelon farmers planting Leting muskmelon in the southern towns of Leting County, so Matouying town is selected as the southernmost area of the investigation). The survey adopted a simple random sampling method to select respondents to ensure that muskmelon farmers in the survey area have an equal chance of being selected to participate in the survey. When we distribute the questionnaire, we will ask the respondents whether they grow melons, and if they grow muskmelons, they can fill in the questionnaire. In addition, all our interviewees are adults over 18 years old, and we do not use the data of minors. Then, the sample size of the total sample was determined according to the population of each town. Finally, 600 questionnaires were distributed, including 543 valid questionnaires, with an effective rate of 89.7%. Face-to-face interviews were used to collect data.

RESULTS

Reliability and validity test

Reliability test

Cronbach's alpha can be used for data reliability test. When $\alpha \geq 0.7$, the data reliability is ideal (BUJANG et al., 2018). The α values calculated by the SPSS.23 are 0.843, 0.804, 0.799, 0.837, 0.856 (Table 1), so this study has good reliability.

Validity test

In the test of structural validity, SPSS.23 was used in this research to measure the model's structural validity through KMO test and Bartlett sphere test. Kaiser believes KMO greater than 0.7 means general (DZIUBAN & SHIRKEY, 1974). Meanwhile, (significance probability of chi square statistical value of Bartlett sphere test) P value < 0.05 , the questionnaire has structural validity and factor analysis can be carried out. It can be seen from table 1 that the values of KMO are 0.842, 0.797, 0.775, 0.814, 0.863; and P values are less than 0.05, explaining that the structural validity of the model is good. In the convergence validity test, the confirmatory factor analysis of AMOS.23 was used to measure the validity of the model by testing the CR and AVE values, and the results are shown in table 1. Jolliffe believes that 0.7 is the acceptable threshold of CR value (JOLLIFFE et al., 1988); Meanwhile, Fornell and Larcker believe that AVE value greater than 0.5

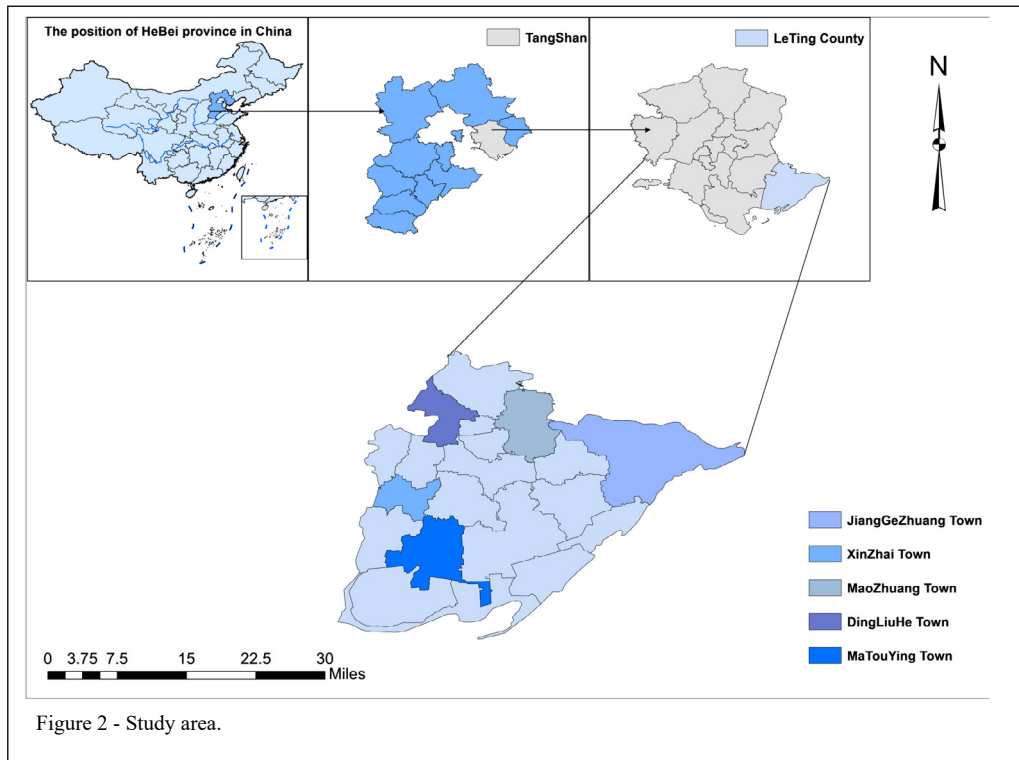


Figure 2 - Study area.

can indicate that the validity is acceptable (FORNELL & LARCKER, 1981). The CR values in this study are 0.843, 0.806, 0.805, 0.838, 0.856, and the AVE values are 0.517, 0.510, 0.509, 0.564, 0.544, indicating that the content of this study is valid.

Fitness text

In this paper, AMOS.23 was used for calculation. Chi-square/DF less than 5 indicates a good fitting degree; RMSEA value less than 0.05 indicates the model fitting is good, and RMSEA value between 0.05-0.08 indicates fair model fitting (BOLLEN & LONG, 1993). The relative fitting index include NFI, RFI, CFI and IFI, etc. When NFI, RFI, CFI and IFI are greater than 0.9, the model fitting degree is good (NASRI & CHARFEDDINE, 2012). It can be seen from table 2 that Chi-square/df is

2.087, RMSEA is 0.045, NFI is 0.938, RFI is 0.928, CFI is 0.967, and IFI is 0.967; all indices meet the requirements, so this study has a good degree of fit.

Hypotheses test

AMOS.23 was used to research the data and the study results of the hypothesis model of behavior intention of Leting muskmelon farmers to apply green organic fertilizer are presented in table 3 and figure 1. The results showed that the H2 and H4 are significant at the level of 0.05. According to the standardized regression coefficient, subjective norm has the greatest positive impact on muskmelon farmers' behavior intention, followed by green cognition; For every 1 standard deviation added to the subjective norm, the farmers' behavior intention will increase by 1.028 standard deviation; For every

Table 1 - Reliability and validity test results.

Constructs	Cronbach's alpha	KMO value	P value	CR	AVE
Attitude (ATT)	0.843	0.842	0.000	0.843	0.517
Subjective norm (SN)	0.804	0.797	0.000	0.806	0.510
Perceived behavioral control (PBC)	0.799	0.775	0.000	0.805	0.509
Green awareness (GA)	0.837	0.814	0.000	0.838	0.564
Intention (INT)	0.856	0.863	0.000	0.856	0.544

Table 2 - Fitness test results.

Fit index	-----Value-----	Acceptable value
Chi-square/df	2.087	< 5
RMSEA	0.045	< 0.08
NFI	0.938	> 0.9
RFI	0.928	> 0.9
CFI	0.967	> 0.9
IFI	0.967	> 0.9

1 standard deviation added to the green awareness, the behavior intention of muskmelon farmers to apply green organic fertilizer will increase by 0.703 standard deviation.

DISCUSSION

First, the results of this study confirmed the important role of subjective norm and green awareness in promoting the intention of muskmelon farmers to apply green organic fertilizer, and again verified the important role of subjective norm in the generation of individual behavior intention and green awareness in the generation of individual environmental protection intention. Secondly; although, the research results unexpectedly reported that the attitude and perceived behavioral control of muskmelon farmers did not significantly promote the intention of muskmelon farmers to apply fertilizer, the study also provided possible explanations for this unexpected research results based on the actual situation.

The effect of attitude on behavior intention

The results demonstrated that the attitude had no crucial positive impact on farmers' intention, so H1 is denied. The change of muskmelon farmers' attitude can not significantly predict their behavior intention to use green organic fertilizer. This result corresponded to the study results of some scholars. Ernst believe that the change of students' environmental

attitude has no crucial impact on their intention to participate in environmental actions, so the results of this paper are acceptable (ERNST et al., 2017). According to the study, several reasons could have contributed to this result. Firstly, whether muskmelon farmers apply green organic fertilizer depends not only on their attitude towards green organic fertilizer, but also on the restrictions of many external factors. Therefore, muskmelon farmers with a positive attitude towards green organic fertilizer may have the intention to refuse to apply green organic fertilizer because of the restrictions of other external factors; Secondly, the low cost, ease of use and short-term efficiency of chemical fertilizer all affect the behavior intention of muskmelon farmers to apply green organic fertilizer.

The effect of subjective norm on behavior intention

The results supported the hypothesis that subjective norm can affect behavior intention significantly and positively, H2 is established. This result corresponded to previous studies, which involved the impact of subjective norm in different domains on behavior intention, such as safe application of chemical fertilizer (SAVARI & GHARECHAE, 2020), green travel (YANG et al., 2020) and organic food purchase (AITKEN et al., 2020). Furthermore, the results also provided crucial support for the positive impact of subjective norm on the behavior intention of muskmelon farmers to apply green organic fertilizer, and believe that subjective norm is the most crucial factor effecting the behavior intention of muskmelon farmers. It strengthens the conclusion that muskmelon farmers are easy to follow social pressure and the expectations of family and friends to change their behavior intention to apply farm fertilizer.

The effect of perceived behavioral control on behavior intention

Another unexpected finding is that perceived behavioral control can not affect behavior intention significantly, thus rejecting H3. This discovery corresponds to other researches, which have

Table 3 - Path estimates.

Hypothesis	-----Path-----	-----Estimate-----	-----P Values-----	-----C.R.-----	-----Significance-----
H1	ATT → INT	-0.565	0.280	-1.079	Not Supported
H2	SN → INT	1.028	0.030	2.172	Supported
H3	PBC → INT	-0.158	0.390	-0.859	Not Supported
H4	GA → INT	0.703	0.004	2.890	Supported

proved that the impact of perceived behavioral control on human behavior intention is insignificant in many fields (ERNST et al., 2017; ZHANG et al., 2019), so the results of this study are acceptable. According to the study, several reasons could have contributed to this result. Firstly, the government's insufficient knowledge dissemination on the application methods and advantages of green organic fertilizer may limit the impact of perceived behavioral control on the behavior intention of muskmelon farmers to apply green organic fertilizer; Secondly, muskmelon farmers have limited understanding or preference for applying green organic fertilizer, which leads to their reluctance to apply green organic fertilizer despite they have the ability to do so. Thirdly, the gap between intention and actual behavior caused by inactive information seeking behavior of melon farmers also limits the impact of perceived behavioral control (ABOELMAGED, 2021).

The effect of green awareness on behavior intention

Consistent with previous studies, the results of this study emphasize that green awareness can have a significant positive impact on muskmelon farmers' application of green organic fertilizer, and H4 is established. This conclusion corresponds to the prior study results of a great quantity of researchers on the effect of green awareness on consumers' behavior or behavior intention of green consumption (AYODELE et al., 2017; SIDDIQUE & HOSSAIN, 2018). This study considered that green awareness is one of the most significant influencing factors of muskmelon farmers' behavior intention. Muskmelon farmers with strong awareness of green environmental protection and sustainable development will also give priority to green production mode in their production process. They closely associate environmental problems with their production and life, and have a stronger preference for green production and life style. Meanwhile, this study also makes up for the lack of research gaps related to farmers' green understanding in the field of agriculture, and emphasizes the important role of muskmelon farmers' green development concept in developing green agriculture.

CONCLUSION

This research is the first attempt to predict the influencing factors of the behavior intention of muskmelon farmers to apply green organic fertilizer in Leting. We confirmed, through the empirical analysis, the usefulness of TPB model as a framework in studying the behavior intention of muskmelon farmers,

and the extended TPB model with green awareness has better prediction ability for muskmelon farmers' behavior intention. The relationship is verified by structural equation model. Through empirical test, we can draw the following conclusions: (1) After incorporating green awareness into theoretical model of planned behavior, green awareness and subjective norm can affect muskmelon farmers' intention to use green organic fertilizer positively and directly; (2) The hypotheses between attitude, perceived behavioral control and behavior intention are not valid.

The theoretical significance of this study lies in: (1) Focusing on the green awareness, this paper investigated the behavior intention of muskmelon farmers. The original TPB model mainly emphasized the influence of rational factors on individual behavior, while ignoring the influence of irrational factors. This study introduced green awareness into TPB model, which supplies a more thorough understanding of the decisive factors of green organic fertilizer application behavior, and is of certain significance to expand the research scope and application prospect of the theory of planned behavior. (2) Most of the existing researches on farmers' behavior intention to carry out green agriculture focus on food and agriculture, but pay little attention to the behavior intention of cash crop growers; with the rapid development of agriculture and economy, cash crops occupy an increasingly important position in agricultural products and have become the focus of green agriculture. Therefore, this study takes cash crop producers as the research object, which is conducive to enrich the study content of farmers' behavior intention and of great significance for attracting more attention to cash crop producers in the academic circle.

In practice: (1) Firstly, the subjective norm of muskmelon farmers can affect their behavior intention of green organic fertilizer application positively. Therefore, decision makers should exert group pressure through the publicity and promotion of green organic fertilizer, change the current atmosphere of resistance to the application of green organic fertilizer, and guide the public to form a positive green production atmosphere. Meanwhile, decision makers should encourage village cadres to take the lead in applying green organic fertilizer, and drive other muskmelon farmers to actively apply green organic fertilizer. (2) Secondly, the green awareness of melon farmers can affect their behavior intention to apply green organic fertilizer positively and significantly. Therefore, decision makers should publicize and educate melon farmers through various forms of media, to improve their attention and sensitivity to environmental

problems, improve their green awareness, further improve the concept that environmental issues are as tightly bound to everyone, increase their psychological investment, and make melon farmers aware of the importance of green environmental protection.

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AUTHORS' CONTRIBUTIONS

Conceptualization: Sha Lou, Xiaoxin Zhang and Dehua Zhang. Data acquisition: Xiaoxin Zhang. Design of methodology and data analysis: Xiaoxin Zhang and Dehua Zhang. Xiaoxin Zhang prepared the draft of the manuscript. All authors critically revised the manuscript and approved of the final version.

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