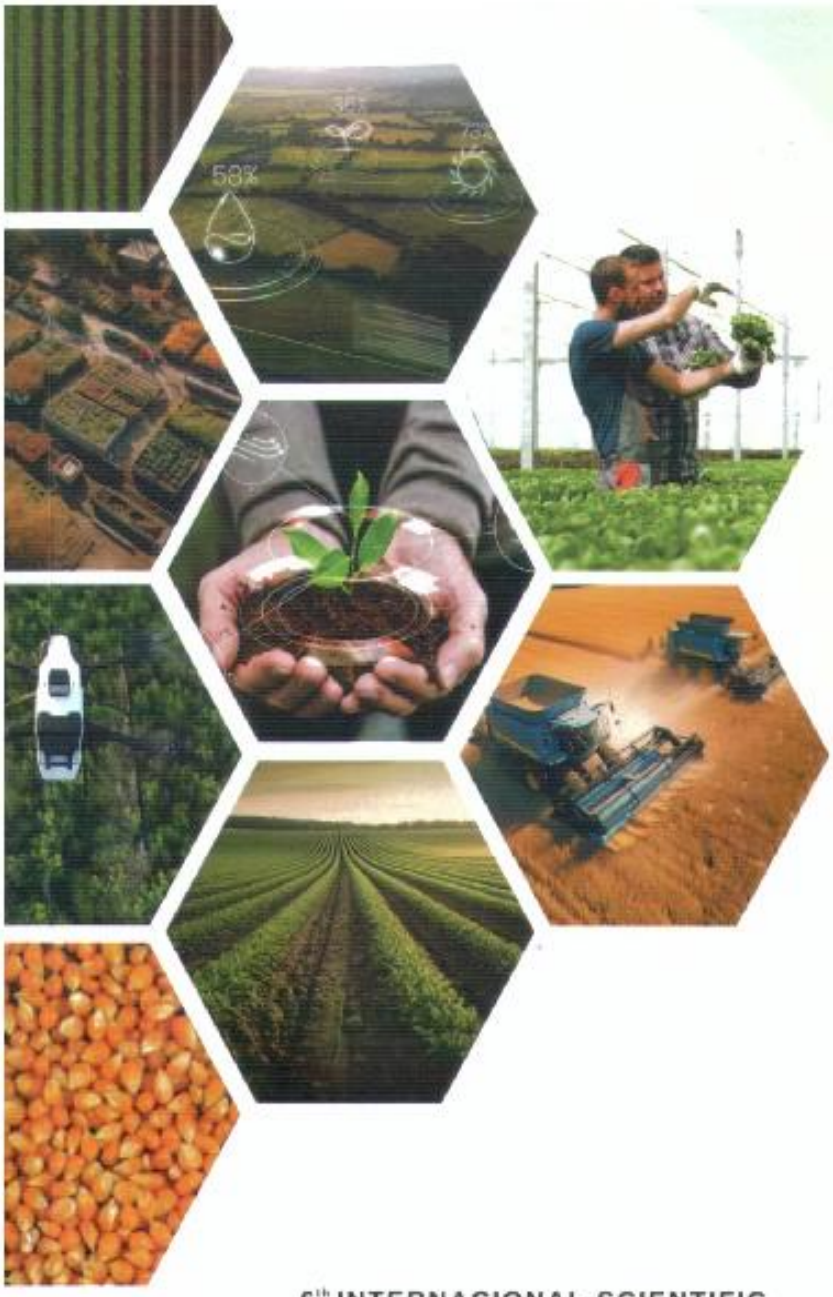

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6th INTERNACIONAL SCIENTIFIC CONFERENCE

VILLAGE AND AGRICULTURE

29. SEPTEMBER AND 30. SEPTEMBER 2023.
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THE EFFECT OF SEASON ON THE PREVALENCE RISK AND EFFECT OF MASTITIS PREVALENCE RISK ON DAILY MILK YIELD

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Abstract

Aiming determination of the variability in the mastitis prevalence risk and the effect of prevalence risk on successive daily milk yield of dairy cows (Holstein and Simmental breed) test-day records collected from 2005 to 2022 were used. As a mastitis risk indicator, daily lactose content was used. The highest mastitis prevalence risk was determined, in both breeds, during the winter period and the lowest during the spring season, with the lower prevalence observed in Simmentals. The effect of mastitis prevalence risk on the cow's productivity at successive milk recordings was more pronounced in the Holstein breed that experienced the higher increase at the I. successive milk recording and high total increase during the analyzed 4-month period than the Simmental. Observed could indicate better overall health and higher resistance of the Simmental breed, as well as a higher recovery capability from subclinical mastitis of Holstein cows.

Key words: *dairy cows, mastitis prevalence risk, daily milk yield, daily lactose content*

Introduction

A sustainable dairy cattle farm implies optimized management and genetically highly valuable animals that will provide high production of high-quality milk. Highly productive animals are frequently sensitive and extremely demanding in terms of keeping conditions, feeding, and prevention. If the above is not at the highest level, a large number of different disorders or diseases often occur. The occurrence of any disorder or disease is highly correlated with a decrease in production and farm profitability. Several disorders can occur in dairy cattle, like mastitis (inflammation of the mammary gland, usually caused by a bacterial infection leading to reduced milk production, alters in milk composition, and significant economic losses due to a decrease in milk quality and quantity); lameness (any abnormality in a cow's gait or ability to walk caused by hoof injuries, infections, laminitis, and negatively affects mobility, productivity, and welfare of an animal); metabolic disorders (milk fever

(hypocalcemia), ketosis (energy deficiency), acidosis, and fatty liver syndrome that occur due to energy and/or nutrients imbalances / deficiencies. Puppel and Kuczyńska (2016) stated that the differences between the genetic production potential and required ration regarding the animal's needs (energy and nutrients) frequently lead to the occurrence of various metabolic disorders. Metabolic disorders and mastitis are one of the priciest and most frequent disorders in dairy farms, and can occur in subclinical or clinical stage. Halasa et al. (2007) stated that both stages of mastitis (subclinical/clinical) cause significant financial losses for dairy farms due to quality and quantity reduction of milk production while Özkan Gülzari et al. (2018) emphasized the negative environmental effect of mastitis prevalence (an increase of greenhouse gas emissions per kg of milk).

Therefore, in order to enable sustainable dairy farming, it is crucial to determine the prevalence in the subclinical stage of certain disorders. Antanaitis et al. (2021) determined the increase in somatic cell counts and the decrease in lactose content in animals with subclinical mastitis. Silanikove et al. (2014) determined that the inflammation of the mammary gland results in cell damage and reduced lactose synthesis that lead to decreased lactose content in milk. Similarly, Pyorala (2003) pointed out that the daily lactose content could be used as an indicator of the prevalence of mastitis. Babnik et al. (2004) defined that daily lactose content lower than 4.5% indicates the prevalence risk of mastitis.

Due to the high importance of mastitis prevention and detection of accurate, uncostly indicators, this research aimed to determine the variability in the mastitis prevalence risk and the effect of prevalence risk on successive daily milk yield of dairy cows (Holstein and Simmental breed) based on test-day records and daily lactose content as a mastitis risk indicator.

Material and methods

For the purpose of statistical analysis test-day records of dairy cattle collected in the period from January / 2005 to December / 2022 in Croatia were used. Test-day records were obtained during regular milk recording according to the alternative milk recording method (AT4 / BT4). Logical control of data included correction for the stage of lactation (5 - 300 days), parity (1 - 10), and age at first calving (21 - 36 months). Furthermore, records with missing or meaningless information concerning the ICAR standards (ICAR, 2017) were deleted from the dataset. The corrected dataset included 3,953,637 test-day records of Holstein and 4,922,751 test-day records of Simmental cows. Accordingly, to daily lactose content (DLC), animals were divided into two classes: healthy animals (DLC > 4.5%); and cows in mastitis risk (DLC < 4.5%). The mastitis prevalence risk was defined as the portion (%) of cows at risk and the portion (%) of healthy cows from the total number of animals. The mastitis prevalence risk was calculated for each recording season separately for each breed. The analysis of the effect of mastitis prevalence risk on subsequent daily

milk yield (at I., II., III., and IV. successive milk recording) was performed on cows with a determined mastitis prevalence risk. The daily production on the day of the milk recording when the mastitis prevalence risk was determined was taken as a reference value. The mastitis index was defined regarding the number of days after the determined risk: D-0 = record on the milk recording when the risk of mastitis was determined, A-1 = within 35 days, A-2 = between 36 and 70 days, A-3 = between 71 and 105 days, and A-4 = more than 105 days. The effect of the mastitis prevalence risk on the daily milk yield was studied separately by recording season and by breed using east square means in MIXED procedure in SAS (SAS Institute Inc., 2019) by the following statistical model:

$$y_{ijklmno} = \mu + b_1(d_i/305) + b_2(d_i/305)^2 + b_3\, ln(305/d_i) + b_4\, ln^2(305/d_i) + A_j + P_k + Y_l + H_m + M_n + e_{ijklmno}$$

where:

$y_{ijklmno}$ = estimated daily milk yield;

μ = intercept;

b_1, b_2, b_3, b_4 = regression coefficients (lactation curve by Ali and Schaeffer, 1987);

d_i = days in milk i (i = 11 to 300 day);

A_j = fixed effect of age at first calving j (j = 21 to 36 month) *only for first parity,

P_k = fixed effect of parity k (k = 1., 2., 3., ≥ 4);

Y_l = fixed effect of year of milk recording l (l = 2005, … 2022);

H_m = fixed effect of herd size m (m = 1, … 6),

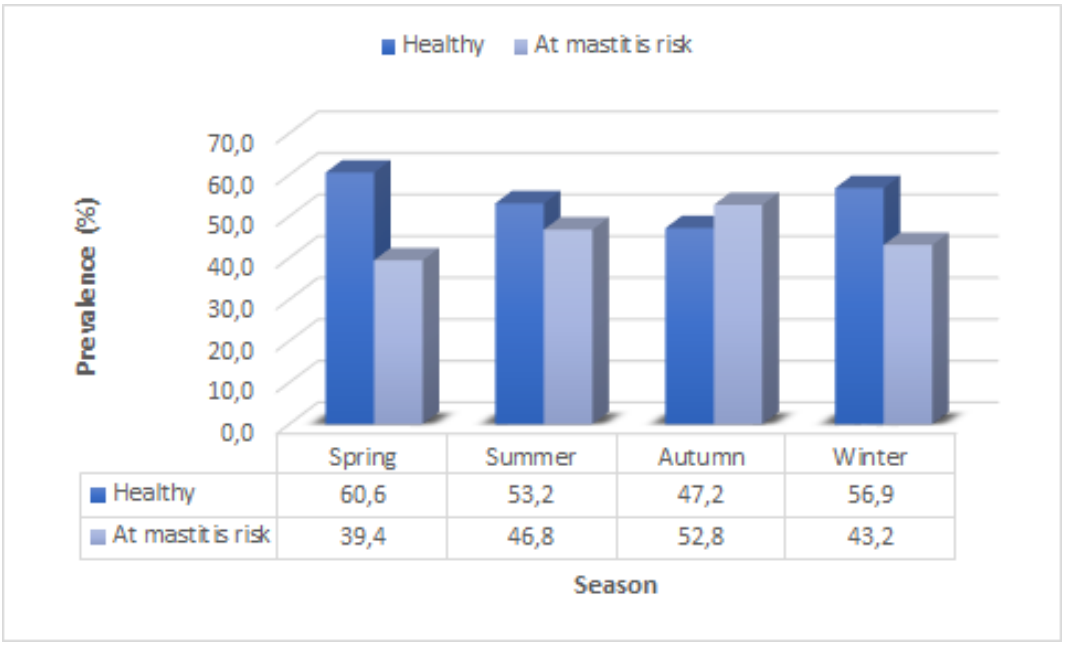
M_n = fixed effect of mastitis index n (n = D–0, A–1, A–2, A–3, A–4);

$e_{ijklmno}$ = residual.

The significance of the differences between the estimated LSmeans was tested by Scheffe's method of multiple comparisons in the MIXED procedure (SAS). Estimated differences in daily milk yield (kg) at successive milk recordings after the determination of mastitis prevalence risk was shown separately by breed.

Results and discussion

The prevalence of Holstein cows at mastitis risk and healthy ones concerning the season of milk recording is presented in Graph 1. The highest prevalence of animals at mastitis risk (indicating subclinical mastitis) was determined in the autumn season in the amount of 52.8%, while the lowest prevalence of animals with possible mastitis was observed in the spring season (39.4%). Furthermore, the highest prevalence of healthy animals in the amount of 60.6% was observed in spring, while the lowest prevalence of cows without mastitis-related problems was observed in the autumn season (47.2%).



Graph 1. Prevalence of healthy and cows at mastitis risk in concerning the season of milk recording for Holstein cattle

The prevalence of cows at mastitis risk and healthy cows for the Simmental breed concerning the season of milk recording is presented in Graph 2. The highest prevalence of cows with the indication of subclinical mastitis (at mastitis risk) was determined in the autumn season (54.0%), while the lowest prevalence of animals with probable mastitis-related problems was observed in the spring season (38.6%). Furthermore, the highest prevalence of healthy animals in the amount of 61.4% was observed in the spring season, while the lowest prevalence of cows without mastitis-related problems was observed in the autumn season (46.0%).

If the health status of both analyzed breeds is compared, the same prevalence trends are visible (the highest prevalence of mastitis risk during the winter period and the lowest during the spring season). In addition, the Simmental breed has a lower prevalence of animals at risk, i.e. a higher prevalence of healthy cows in all seasons, which indicates a better state of health and higher resistance of the Simmental breed.

Graph 2. Prevalence of healthy and cows at mastitis risk in concerning the season of milk recording for Holstein cattle

In the further analysis, only animals that were at risk of mastitis were included, and their daily milk production was monitored during the following four successive milk recordings (approx. 4 months after the detection of the risk of mastitis). Estimated differences in daily milk yield (kg) at successive milk recordings after the detection of mastitis prevalence risk for Holstein cows are presented in Table 1.

Table 1. Estimated differences in daily milk production (kg) at successive milk recordings after the detection of mastitis prevalence risk for Holstein cows concerning milk recording season

Recording Season	I. milk recording	II. milk recording	III. milk recording	IV. milk recording	Total
Spring	20.410	2.830	2.573	8.803	34.616
Summer	11.648	-1.0637	-0.571	8.167	18.181
Autumn	19.968	2.326	-1.078	-0.737	20.480
Winter	24.040	3.176	-1.933	5.183	30.467

Holstein cows, at first milk recordings after the detection of mastitis prevalence risk, experienced an increase in milk production in amount from 11.648 kg/day in the summer season to 24.040 kg/day during the winter season. During the spring season, Holstein cows had a constant increase in milk production at all analyzed milk recordings, while in other seasons cows experienced variations in milk production (depending on the number of successive milk recordings (I. – IV.). Furthermore, the

highest total increase in milk production was determined in the amount of 34.616 kg/day was observed in the spring season, while the lowest total increase was observed in the summer season (18.181 kg/day).

Estimated differences in daily milk yield (kg) at successive milk recordings after the detection of mastitis prevalence risk for Simmental cows are presented in Table 2. The highest difference in milk production at the first successive milk recording was determined in the spring season (10.314 kg/day) while the lowest difference was in the autumn season. In further successive milk recordings, Simmental cows experienced a decrease in daily milk production except for the summer season at III. milk recording. The total difference in the analyzed period amounted from 4.347 kg/day in summer to -4.537 kg/day in winter season indicating higher recuperation ability of Simmental cows in the spring season.

Table 2. Estimated differences in daily milk production (kg) at successive milk recordings after the detection of mastitis prevalence risk for Simmental cows concerning milk recording season

Recording Season	I. milk recording	II. milk recording	III. milk recording	IV. milk recording	Total
Spring	10.314	-0.264	-1.225	-4.833	3.992
Summer	5.978	-1.694	0.244	-0.181	4.347
Autumn	3.943	-1.582	-2.374	-0.877	-0.890
Winter	7.692	-5.995	-3.643	-2.591	-4.537

If the performances of both breeds are compared, the impact of the mastitis prevalence risk on the productivity of the cow during successive milk recordings was highly pronounced in the Holstein breed with the higher increase at the I. successive milk recording and high total increase during analyzed 4-month period in comparison to Simmental breed. Observed could indicate a higher possibility of recovery from subclinical mastitis in Holstein than in Simmental cows.

Nobrega and Langoni (2011) state that cows had a higher level of lactose in the dry season than in the rainy season. Furthermore, Sharma et al. (2018) reported that the incidence of mastitis was highest during the early autumn or winter and rainy season. Similar results were found by Tomazi et al. (2018) who reported that the risk of intramammary infections was higher in the months with the highest temperatures and humidity in the environment, which is a combination that induces heat stress in dairy cows. Gantner et al. (2011) and Haygert-Velho et al. (2018) state that heat stress, expressed in summer and autumn, can contribute to variations in milk production and lactose content of lactating cows. Similarly, Weber et al. (2020), in a study conducted in Brazil, found a lower percentage of lactose and a higher number of SCC in the Holstein breed during summer and autumn. The same authors state that in winter and spring, the milk was of higher quality, while in the hotter months of

summer and autumn, the quality and availability of forage and the frequency of mastitis (increased SCC) negatively affected the quality of milk.

Conclusion

The research results indicate the presence of variability in the mastitis prevalence risk and the effect of prevalence risk on milk production at successive recordings concerning the season of milk recording and the breed of dairy cows (Holstein and Simmental breed). Regarding the mastitis prevalence risk, the same trends were determined in both breeds with the highest prevalence of mastitis risk during the winter period and the lowest during the spring season. Furthermore, in the Simmental breed, a lower prevalence of animals at risk than in Holstein was determined in all seasons indicating better health and higher resistance of the Simmental breed. Regarding the effect of the mastitis prevalence risk on the cow's productivity at successive milk recordings, in the Holstein breed the higher increase at the I. successive milk recording and high total increase during the analyzed 4-month period than in Simmental was found. Observed could indicate a higher recovery capability from subclinical mastitis in Holstein than in Simmental cows.

References

1. Antanaitis, R., Juozaitienė, V., Jonike. V., Baumgartner, W., Paulauskas, A. (2021): Milk lactose as a biomarker of subclinical mastitis in dairy cows. Animals 11. 1–11
2. Babnik, D., Verbič, J., Podgoršek, P., Jeretina, J., Perpar, T., Logar, B., Sadar, M., Ivanovič, B. (2004): 'Priročnik za vodenje prehrane krav molznic ob pomoči rezultatov mlečne kontrole'. Kmetiljsi inštitut Slovenije.
3. Gantner V., Mijić P., Kuterovac K., Solić D., Gantner R. (2011): Temperature-humidity index values and their significance on the daily production of dairy cattle. Mljekarstvo, 61(1), pp. 56–63.
4. Halasa, T., Huijps, K., Østerås, O., Hogeveen, H. (2007): Economic effects of bovine mastitis and mastitis management: A review. Veterinary Quarterly, 29(1), 18–31.
5. Haygert-Velho, I.M.P., da ConceiÇÃo, G.M., Cosmam, L.C., Alessio, D.R.M., Busanello, M., Sippert, M.R., Damiani, C., Almeida, A.P.A., Velho, J.P. (2018): Multivariate analysis relating milk production, milk composition, and seasons of the year. Anais Da Academia Brasileira de Ciencias, 90(4), 3839–3852.
6. ICAR. Guidelines for Dairy Cattle Milk Recording. Guidelines (2017).
7. Özkan Gülzari, Ş., Vosough Ahmadi, B., Stott, A. W. (2018): Impact of subclinical mastitis on greenhouse gas emissions intensity and profitability of dairy cows in Norway. Preventive Veterinary Medicine, 150(October 2017), 19–29.
8. Pyorala, S. (2003): Indicators of inflammation in the diagnosis of mastitis. Veterinary Research, 34(5), 565–578.

9. SAS Institute Inc. (2019): SAS User' s Guide, Version 9.4. SAS Institute Inc. Cary, NC.
10. Sharma, N., Gurdeep Singh, S., Sharma, S., Misri, J., Gupta, S., Hussain, K. (2018): Mastitis Occurrence Pattern in Dairy Cows and Importance of Related Risk Factors in the Occurrence of Mastitis. Journal of Animal Research, 2(April), 315–326.
11. Silanikove, N., Merin, U., Shapiro, F., Leitner, G. (2014): Milk metabolites as indicators of mammary gland functions and milk quality. Journal of Dairy Research, 81(3), 358–363.
12. Tomazi, T., Ferreira, G.C., Orsi, A. M., Gonçalves, J.L., Ospina, P.A., Nydam, D.V., Moroni, P., dos Santos, M.V. (2018): Association of herd-level risk factors and incidence rate of clinical mastitis in 20 Brazilian dairy herds. Preventive Veterinary Medicine, 161(April), 9–18.
13. Weber, C.T., Corrêa Schneider, C.L., Busanello, M., Bandeira Calgaro, J.L., Fioresi, J., Gehrke, C.R., da Conceição, J.M., Haygert-Velho, I.M.P. (2020): Season effects on the composition of milk produced by a Holstein herd managed under semi-confinement followed by compost bedded dairy barn management. Semina: Ciencias Agrarias, 41(5), 1667–1678.

UTJECAJ SEZONE NA RIZIK PREVALENCIJE I UTJECAJ RIZIKA PREVALENCIJE MASTITISA NA DNEVNU KOLIČINU MLIJEKA

Sažetak

U cilju utvrđivanja varijabilnosti u riziku od pojavnosti mastitisa i utjecaja rizika od pojavnosti na sukcesivnu dnevnu količinu mlijeka mliječnih krava (holstein i simentalske pasmine) korišteni su zapisi na kontrolni dan prikupljeni od 2005. do 2022. godine. Kao indikator rizika od mastitisa korišten je dnevni sadržaj laktoze. Najveći rizik od pojavnosti mastitisa utvrđen je, u obje pasmine, u zimskom razdoblju, a najmanji u proljetnoj sezoni, s nižom pojavnosti u simentalske pasmine. Utjecaj rizika od pojavnosti mastitisa na produktivnost krava pri uzastopnim kontrolama mliječnosti bio je izraženiji kod holstein pasmine koja je imala veći porast pri I. sukcesivnoj kontroli mliječnosti i veći ukupni porast proizvodnosti tijekom analiziranog 4-mjesečnog razdoblja od simentalske pasmine. Utvrđeni rezultati bi mogli ukazivati na bolje opće zdravlje i veću otpornost simentalske, kao i na veću sposobnost oporavka od subkliničkog mastitisa Holstein pasmine.

Ključne riječi: mliječne krave, rizik pojavnosti mastitisa, dnevna količina mlijeka, dnevni sadržaj laktoze

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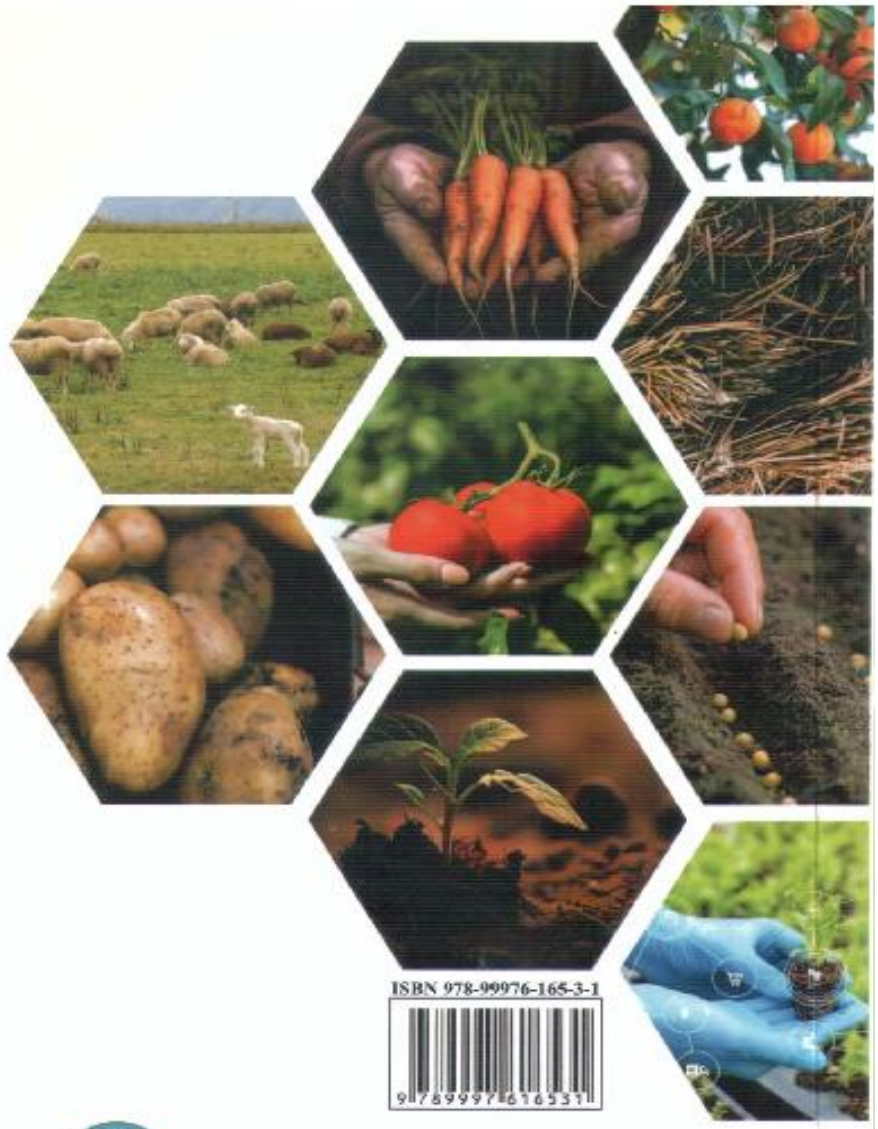

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