College of Agriculture & Natural Resources
Department of Horticulture

HRT 403 Handling and Storage of Horticultural Crops

(3 Credit hours)
(Fall 2024)
Plant & Soil Science Building A182

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Class meets Monday, Wednesday, and Friday 10:20 – 11:10 am
Office hours are directly after class or by appointment
(Please email my regular MSU email address not my D2L email to schedule an appointment)

Course objective: This is a middle level course that describes the basic principles of postharvest biology and technology. The aim is to outline the biological processes that occur in horticultural crops after harvest that directly impact product quality and the practical strategies that are used to reduce rates of postharvest decay and maintain quality. The course integrates basic biological knowledge with industry practices and introduces current research topics. The course is focused on examining the key concepts of postharvest biology that can be applied to multiple crops rather than exhaustively detailing handling and storage criteria for specific crops. A key underlying principle of the course is its relevance to society as it relates to us as consumers, but also more broadly to global food supplies and food security.

Expected outcomes: Following completion of this course the student should have an appreciation of how horticultural crops are harvested, handled, and stored. Students will develop an understanding of the biological factors and processes that determine the postharvest quality of horticultural crops, the processes that contribute to crop deterioration, and strategies for reducing the rate of postharvest decay. This knowledge will be readily applicable for solving problems associated with the handling and storage of horticultural crops and will also make you better informed consumers.

Course philosophy: "Slow and steady wins the race!!!" At times, the course may be challenging. You will be introduced to current research topics using research papers as examples to illustrate key postharvest physiological concepts. You will need to evaluate some of these papers and provide your own review of their findings. You will also analyze experimental data. There will be some occasions where you find this difficult. It will require a time investment on your part to complete course assignments to the expected standard. If you are the type of student who does their assignments at the last minute, you will find this course difficult. If you plan your time wisely and work consistently throughout the semester you will be successful. *The number one thing to remember is that I am here to help*. If you do not understand something or you need additional help or have questions or concerns, please ask (and if needed, ask again). I want you to enjoy this course and hope that you feel it was a worthwhile investment of your time and effort. However, I am a firm believer in the adage, "you get out what you put in". If you're not committed to learning or want an easy course, you will be disappointed.

Course format: Class will meet in person. Class meetings will consist of a combination of discussions and lectures. Where possible, I prefer the discussion and "chalk-talk" format but there will also be more

traditional lectures. PowerPoint slide sets and other course materials, including assignments will be placed on D2L.

Course resources

There are several **postharvest-related textbooks** books that I have used a little for course preparation, each has its own merit but two of them are old and have not been updated. You are **NOT** required to purchase these books.

1) Postharvest: an introduction to the physiology & handling of fruit, vegetables & ornamentals 6th edition (by Ron Wills and Golding) CABI (2016) ISBN-10: 9781786391483
   This is a basic text that describes many of the important concepts of postharvest handling and storage of horticultural crops. It is useful for all students.

2) Postharvest technology of horticultural crops (Adel Kader, technical editor, UC-Davis) (2002) ISBN 1879906511 Library Call # SB130.K38 2004
   This is an older text that is a little more applied in focus. It still contains many useful items although is a little out of date in some areas and more up to date information can be found online.

3) Postharvest Biology (by Stanley J. Kays & Robert Paull) (2004) ISBN 1888186542 Library Call # SB130.K38 2004
   This is an advanced text that is most suitable for graduate students or those students with a very specific interest in postharvest. Again, this text is out of date and some of the information will no longer be relevant.

Electronic resources available through MSU Libraries

There are several postharvest related books that are available electronically through the MSU library. You can search for these using the title. These are fairly new and will have more up to date information than the textbooks.

1) Postharvest Handling – A systems approach (2014) (3rd Edition) edited by Wojciech J. Florkowski... [et al.]

2) Postharvest Physiology and Biochemistry of Fruits and Vegetables (2019) edited by Yahia & Carrillo-López

3) Preharvest Modulation of Postharvest Fruit and Vegetable Quality (2018) edited by Siddiqui MW

4) Postharvest Extension and Capacity Building for the Developing World (2019) edited by Mohammed M & Tokala VY

5) Advances in Postharvest Management of Horticultural Produce (2020) edited by Watkins C

Additional useful general plant biology textbooks

Again, these are **not** required but you may already have at least one of them from taking other classes.

1) The Molecular Life of Plants (Jones, Ougham, Thomas & Waaland 2013) Call Number QK728.M364 2012

2) Plant Physiology and Development (Taiz et al., 2015) Sixth Edition Call Number QK711.2.T35 2015
(Note, older editions of this text are also useful)

Useful websites: I will provide you with many resources throughout the class both in terms of scientific papers and appropriate websites. However, some of the most useful websites are provided below. These are often a great place to start when completing assignments and contain links to many other resources.

http://postharvest.ucdavis.edu
http://www.fao.org/platform-food-loss-waste/en/
http://www.fao.org/in-action/inpho/home/en/
http://postharvest.ifas.ufl.edu
https://www.ars.usda.gov/ARSUserFiles/oc/np/CommercialStorage/CommercialStorage.pdf

Assignments and Assessment

Each of us learns in a different way; through reading, visualization or activities. HRT 403 allows multiple opportunities and methods of learning. Similarly, each of us performs differently or prefers different assessment methods. For example, some students prefer exams over written assignments, others may prefer presentations or data analysis exercises. I have structured the course so that there are multiple opportunities to assess student knowledge. I feel that this gives everyone a fair chance to perform to the best of their ability. **Please note, with the exception of the midterm and final exams all other assignments must be submitted electronically as either pdf or MS word files through the dropbox feature of D2L.** The Turnitin feature will be enabled on all class submissions as follows:

Consistent with MSU's efforts to enhance student learning, foster honesty, and maintain integrity in our academic processes, instructors may use a tool called Turnitin to compare a student's work with multiple sources. The tool compares each student's work with an extensive database of prior publications and papers, providing links to possible matches and a "similarity score." The tool does not determine whether plagiarism has occurred or not. Instead, the instructor must make a complete assessment and judge the originality of the student's work. All submissions to this course may be checked using this tool.

Students should submit papers to Turnitin Dropboxes without identifying information included in the paper (e.g., name or student number), the system will automatically show this information to faculty in your course when viewing the submission, but the information will not be retained by Turnitin.

Student submissions will be retained only in the MSU repository hosted by Turnitin.

Examinations: There will be **two midterm exams** to test disciplinary knowledge. These will be short answer format. The final exam is scheduled on **Friday December 13th** (7:45 – 9:45 am) and will also be short answer format but will involve more postharvest problem-solving scenarios. The final exam is comprehensive (includes all course material) and will test the application of knowledge learned throughout the course.

Data Analyses Exercises: We will perform analyses of data previously collected from postharvest experiments. We will discuss these experiments and the data that was collected in class. You will be required to complete two lab reports. *Details of how to prepare a lab report are available on the course D2L site.*

Chilling Injury Case Study: During the middle of the semester, we will perform an in-depth analysis of a research paper that covers two important aspects of postharvest biology; chilling injury and fruit ripening. Specific details will be shared separately and posted on the D2L site.

Creation of a Postharvest Fact Sheet and Presentation: You will be required to perform research into and write a produce factsheet focused on postharvest handling and storage of a particular crop that is aimed at growers and industry professionals. Details will be discussed in class and provided on the D2 website.

Review Paper and Presentation: You will write a review paper on a topic of your choice related to postharvest biology. You will also give a presentation on this topic towards the end of class. Details will be discussed in class and provided on the D2L website.

Participation: I am expecting participation in class. I am a firm believer that you get out something what you are willing to put in. There's no point being disappointed about the hard work and effort that you didn't put in – so please make an effort to participate in class. I will keep a record of attendance, but the points allocated for participation will also depend on your engagement during the class. For example, whether you readily participate in class discussions and group activities.

Important Class Dates: The table below gives a list of **deadlines** for assignments and presentations. I have attempted to schedule these dates to minimize overload. I am always happy to receive assignments early but less happy to receive them late. **Assignments are to be received by 6 pm on the respective due date. Five points will be deducted from late assignments.**

Assignment	Due date
Midterm #1 (lectures 1 through 9)	9/23/2024
Produce specific presentation	9/25/2024 9/27/2024
Produce Fact Sheet	10/2/2024
Confirm choice of postharvest review topic	10/4/2024
Data analyses report #1: fruit quality and maturity	10/14/2024
Chilling Injury – case study	10/24/2024
Midterm #2 (lectures 10 through 18)	11/1/2024
Data analyses report #2: CA and MAP storage	11/4/2024
Class presentations – postharvest review (groups I through IV)	11/11/2024 through 11/18/2024
Postharvest Review Paper Submission	11/25/2024
Final exam (cumulative format)	12/13/2024

Grading: I will try hard to get graded assignments back to you as quickly as possible, with comments that I hope will be useful. If there are common themes where important concepts are being misinterpreted, we will review these in class. You are encouraged to meet with me to talk about assessments and quizzes if you are concerned about items that you may have missed or do not understand.

Points are awarded as follows:

Assessment	Points Available
Midterm #1	50
Midterm #2	50
Final Exam	100
Produce Fact Sheet	40 (30 for the fact sheet + 10 for the associated presentation)
Postharvest Review Paper	70 points (50 for the paper + 20 for the associated presentation)
Data Analyses & interpretation exercises	60 (2 x 30)
Chilling Injury Case Study	40 (30 for the assignment + 10 for the class discussion)
Participation	40
Total	450

Grades will be awarded as follows:

Points	Grade
420 - 450	4.0
395 - 419	3.5
370 - 394	3.0
345 - 369	2.5
320 – 344	2.0
295 - 319	1.5
270 - 294	1.0
< 270	0.0

University and Class Expectations

Spartan Code of Honor: Academic Pledge: "As a Spartan, I will strive to uphold values of the highest ethical standard. I will practice honesty in my work, foster honesty in my peers, and take pride in knowing that honor in ownership is worth more than grades. I will carry these values beyond my time as a student at Michigan State University, continuing the endeavor to build personal integrity in all that I do."
https://msu.edu/unit/ombud./academic-integrity/Spartan%20Code%20of%20Honor%20Academic%20Pledge.html

Diversity Equity and Inclusiveness
Diversity, Equity and Inclusion are important, interdependent components of everyday life in the College of Agriculture and Natural Resources (CANR) and are critical to our pursuit of academic excellence. Our aim is to foster a culture where every member of CANR feels valued, supported and inspired to achieve individual and common goals with an uncommon will. This includes providing opportunity and access for all people across differences of race, age, color, ethnicity, gender, sexual orientation, gender identity, gender expression, religion, national origin, migratory status, disability / abilities, political affiliation, veteran status and socioeconomic background. (See the full CANR statement: https://www.canr.msu.edu/news/canr-statement-on-diversity-equity-and-inclusion)

Commit to Integrity: Academic Honesty
Article 2.3.3 of the Academic Freedom Report states that "The student shares with the faculty the responsibility for maintaining the integrity of scholarship, grades, and professional standards." In addition, the Department of Horticulture and HRT403 adheres to the policies on academic honesty as specified in General Student Regulations 1.0, Protection of Scholarship and Grades; the all-University Policy on Integrity of Scholarship and Grades; and Ordinance 17.00, Examinations. (See Spartan Life: Student Handbook and Resource Guide and/or the MSU Web site: www.msu.edu.)

Therefore, unless authorized by your instructor, you are expected to complete all course assignments, including homework, lab work, quizzes, tests and exams, without assistance from any source. You are expected to develop original work for this course; therefore, you may not submit course work you completed for another course to satisfy the requirements for this course. Also, you are not authorized to use the www.allmsu.com Web site to complete any course work in this course. Students who violate MSU academic integrity rules may receive a penalty grade, including a failing grade on the assignment or in the course. Contact your instructor if you are unsure about the appropriateness of your course work. (See also the Academic Integrity webpage.)

Inform Your Instructor of Any Accommodations Needed
Michigan State University is committed to providing equal opportunity for participation in all programs, services and activities. Requests for accommodations by persons with disabilities may be made by contacting the Resource Center for Persons with Disabilities at 517-884-RCPD or on the web at rcpd.msu.edu. Once your eligibility for accommodations has been determined, you will be issued an Accommodation Letter. Please present this letter to me at the start of the term and/or two weeks prior to the accommodation date (test, project, etc). Requests received after this date will be honored whenever possible.

Participation and Engagement
During all classes, the instructor expects students to be fully engaged and prepared to discuss reading assignments. Students are encouraged to ask questions of the instructor, guest speakers, and their peers.

Active participation includes, but is not limited to, the following behaviors:
1. Asking and answering questions of the instructors, peers, or guest speakers
2. Bringing forth new ideas, information, or perspectives to academic conversations
3. Discussing your readings and reflections with instructors and peers
4. Meeting with the instructors to discuss your interests, assignments, or project
5. Questioning information presented and discussed
6. Participating in small group discussions and activities
7. Assuming responsibility for personal behavior and learning

While working on group projects, students should be mindful of other students in their group; therefore, it is important for all participants to exercise:

- Respect for themselves, each other
- Openness and a positive attitude toward new ideas and other's ideas
- Flexibility and tolerance of ambiguity
- Good communications amongst themselves.

Attendance:

There is a well-established correlation between attendance in class and the grade achieved. There is a high likelihood that if you miss lots of classes and fail to complete assignments your grade will be low. If you have a valid reason for missing class and you know of this in advance or if you are ill, please let me know by email so that I am aware of the situation. MSU has a Grief Absence Policy that must be followed in the event of a family bereavement. Details are available at https://reg.msu.edu/ROInfo/Notices/GriefAbsence.aspx

University Attendance Policy:

REPORTING NON-ATTENDANCE. In compliance with federal regulations *governing financial aid* and veterans education benefits, *instructors are required to report students who stop attending or who have never attended class*. After the first week of classes, through the middle of the term of instruction, instructors who identify a non-attending student should notify their departmental office. Upon receiving a report of non-attendance, *departmental representatives are encouraged to initiate an administrative drop*.

"Attendance" is defined as physical attendance or participation in an academically related activity such as submission of an assignment, an examination, participation in a study group or an online discussion, etc. Instructors who do not take attendance may utilize key assessment points (e.g. projects, papers, mid-term exams, and discussions) as benchmarks for participation.

DROP FOR NON-ATTENDANCE. Students may be dropped from a course for non-attendance by a departmental administrative drop any time after the fourth class period, or the fifth class day of the term of instruction, whichever occurs first.

University Policy on Religious Observance

It has always been the policy of the University to permit students and faculty to observe those holidays set aside by their chosen religious faith. The faculty and staff should be sensitive to the observance of these holidays so that students who absent themselves from classes on these days are not seriously disadvantaged. It is the responsibility of those students who wish to be absent to make arrangements in advance with their instructors. ***Please let me know within one week from the beginning of class if you need to be absent for Observance of a Religious Holiday or Festival.*** Additional information on this MSU policy can be found at https://reg.msu.edu/ROInfo/Notices/ReligiousPolicy.aspx

Additional College and University Policies

All other general college and university policies applicable to this course are available at https://www.canr.msu.edu/academics/courses/policies . Please review these policies.

HRT 403 Handling and Storage of Horticultural Crops (Fall 2024)

Class Schedule

Monday, Wednesday & Friday

10:20am – 11:10 am

Date	Day	Lecture #	Subject
8/26	M		Introductions, expectations & assignments
8/28	W		Key concepts
8/30	F	1	Significance of Postharvest I
9/2	M	No class	Labor Day
9/4	W	2	Significance of Postharvest II
9/6	F	3	Compositional changes in horticultural crops I
9/9	M	4	Compositional changes in horticultural crops II
9/11	W	5	Fruit ripening I
9/13	F	6	Fruit ripening II
9/16	M	7	Senescence
9/18	W	8	Ethylene control
9/20	F	9	Respiration and management of respiration
9/23	M	Exam	Midterm #1 (lectures 1 through 9)
9/25	W	presentation	Produce fact sheet presentations I
9/27	F	presentation	Produce fact sheet presentations II
9/30	M	10	Water Relations / water stress and humidity management
10/2	W	11	Quality and Maturity
10/4	F	Data	Apple Fruit Maturity Lab and Data Discussion
10/7	M	12	Harvesting and Packing operations I
10/9	W	13	Harvesting and Packing operations II
10/11	F	14	Temperature management
10/14	M	15	Packaging
10/16	W	16	Controlled and Modified Atmosphere Storage - Dr. Randy Beaudry
10/18	F	Data	Controlled and Modified Atmosphere Storage Lab and Data Discussion
10/21	M	No class	Fall break
10/23	W	17	Transportation
10/25	F	18	Postharvest Temperature Stress & management strategies
10/28	M	Case study	Fruit Chilling Injury Case Study - class discussion
10/30	W	Case study	Fruit Chilling Injury Case Study - class discussion
11/1	F	19	Physiological disorders
11/4	M	20	Postharvest Pathology
11/6	W	Exam	Midterm #2 (lectures 10 through 18)
11/8	F	21	Postharvest insect and pest control
11/11	M	presentation	Class presentations postharvest review topic I
11/13	W	presentation	Class presentations postharvest review topic II
11/15	F	presentation	Class presentations postharvest review topic III
11/18	M	presentation	Class presentations postharvest review topic IV
11/20	W	22	Postharvest challenges: postharvest handling of organic crops
11/22	F	23	Overview of the Michigan Potato Industry and Potato Storage – Chris Long
11/25	M	24	Postharvest challenges in developing countries – Randy Beaudry

Date	Day	Lecture #	Subject
11/27	W		Office Hours
11/29	F	No Class	Thanksgiving Break
12/2	M	25	Postharvest handling of ornamental crops
12/4	W	26	Postharvest challenges: minimally processed foods
12/6	F	review	Course review session – students must submit review topics by 12/2/2024
12/13	F	Final exam	Comprehensive final examination -- cumulative (7:45 – 9:45 am)